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Index to Advertisers and Classified Index Following Reading Matter.

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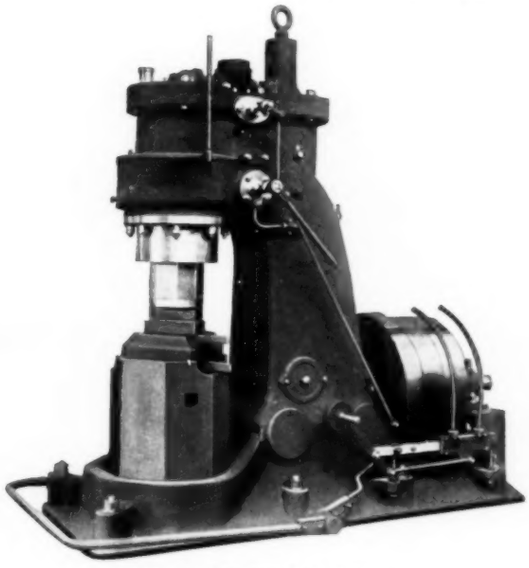

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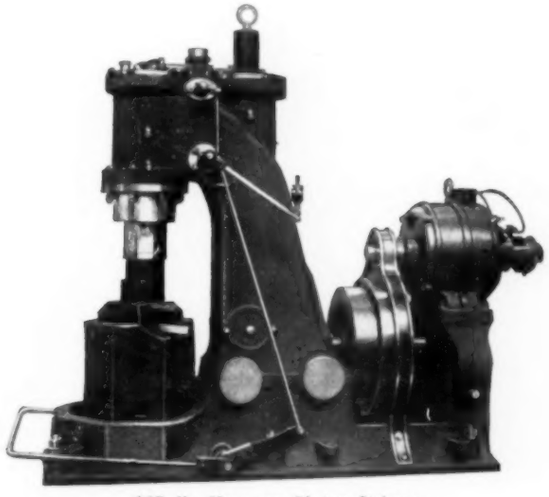

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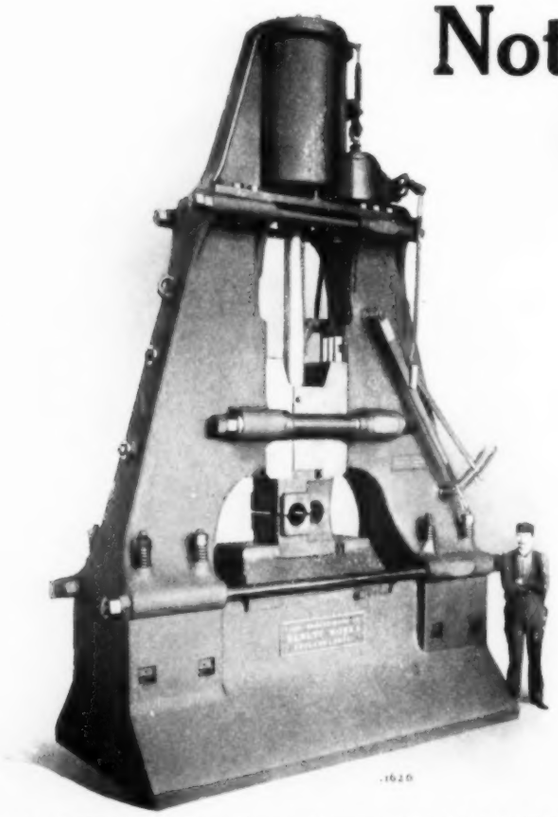

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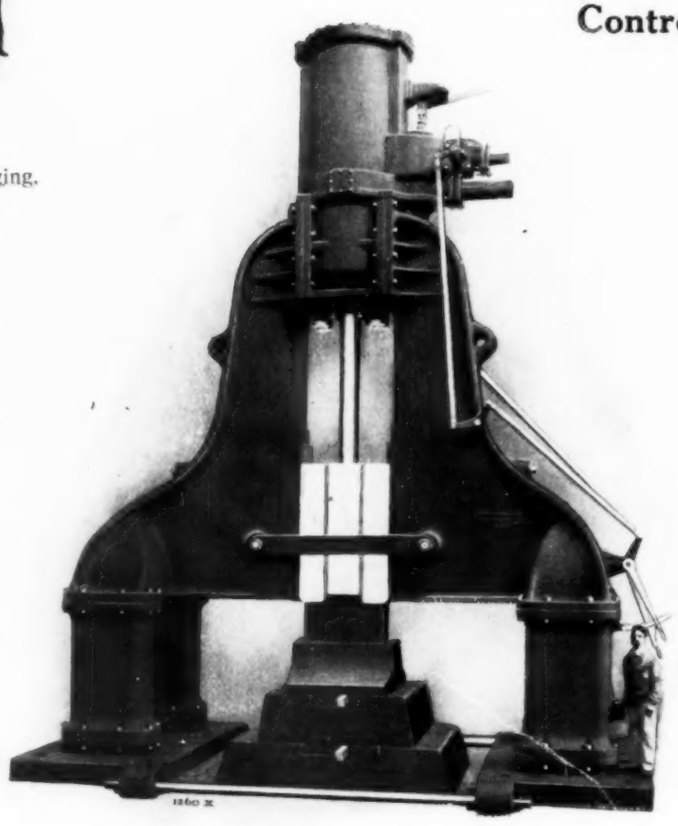

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(*See pages* 35, 36, 37, 38, 39, 40, 41 *and* 42)

From Pig Iron to Finished Steel Wire

Interesting Methods Followed by the American Steel and Wire Company, from the Open Hearth Furnace to the Drawing Block

EDITORIAL CORRESPONDENCE

The making of steel wire in the large wire mills, such as those of the American Steel and Wire Company, begins with pig iron and winds up with the finished product. The illustrations which accompany this article were secured from the South Works of the Worcester, Mass., plant of this company, to whom we are also indebted for the information.

In Fig. 1 is a Wellman-Seaver furnace-charging machine with the charge being dumped into the open-hearth furnace. These charging machines are entirely controlled by the operator shown in the center and can be run along the track in front of any furnace and when properly located, the carriage occupied by the operator is run back and forth shoving the charge into the furnace, turning the long bar and dropping the charge and withdrawing the empty bucket. These buckets are about 6 feet long and hold about 800 pounds of iron at each charge.

One of these is shown on the ground in front of the man in Fig. 2, and carries a pocket at the left-hand end, a square sort of a head on the end of the bar fitting into this pocket, and the weight of the bucket and its load keeps it always in position until the empty bucket has been brought out and laid on one of these cars which runs on the narrow-gage track near the furnaces and carries the bucket to the right position for the charging machine to handle.

Fig. 2 shows the lower side of the open-hearth furnaces with the huge 50-ton pouring ladle, while at the extreme right is a train of ingot molds, which have just been poured. These are shown much more clearly in Fig. 3, where the train has been run through the ingot rolling mill and the molds are being stripped from the hot ingot. These are usually red hot when they leave the shed in front of the furnaces and are still very warm when the molds are stripped, but cool enough to retain their shape.

Stripping the Molds

As can readily be seen in Fig. 3, the ram containing the two links reaches down until the links drop over the ears on the side of the mold, and while this is being lifted the central plunger holds the ingot down on the car. The molds are then transferred to the train at the left, which goes back to the furnaces to be used during the next pouring.

Before the ingots have cooled to any great extent, they are picked up by the heavy tongs, shown in Fig. 4, and carried over to be reheated in the soaking pit before being rolled. After being reheated one of the ingots is brought over to be started in the roll train and is dropped upright into the receiving holder when it is in a horizontal position. The hydraulic cylinder shown behind the holder tilts this into the position shown and starts the heated ingot on its way through the rolling mill.

The Ingot Rolling Mill

This is very clearly shown in Fig. 5 where the heated ingot has received its first pass through the rolls and a finished bar is shown at the other side just running off to the right. The reducing rolls are moved down by the long hydraulic cylinder shown in front of the numbered scale. This controls the rack, of which the back only can be seen and this engages a pinion below the large gear wheel in the center. The rack is held in place by the rollers shown in the cross-beam. The large gear wheel turns both the pinions which operate the screws that force both bearings of the reducing rolls down at a uniform rate.

The reduction is shown by the scale and both this and the reversal of the roller train are controlled by the operators, who are not shown in position. It is rather interesting to note the form of the connecting shaft between the driving coupling under the scale and the reducing rolls which make them free to move approximately 16 inches vertically to accommodate the billet and allow it to be rolled down to a 4-inch bar.

The ingot is about 18 inches square and 5 feet long, weighing 4000 pounds. This is reduced to about a 4-inch square section and cut up in lengths of 4 feet 6 inches called billets. These go to another mill with very much smaller rolls which rolls the billets into round rods about an inch in diameter and is known as the rod mill.

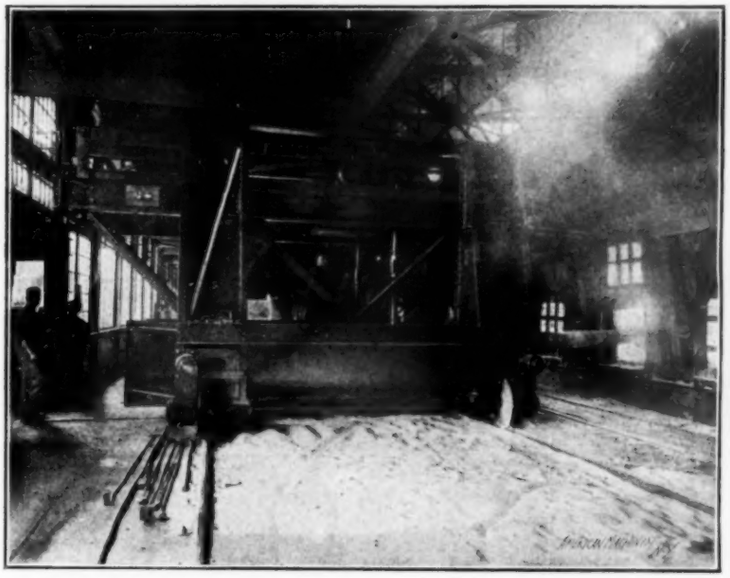


FIG. 1. CHARGING THE FURNACES

FIG. 2. WHERE THE INGOTS ARE POURED

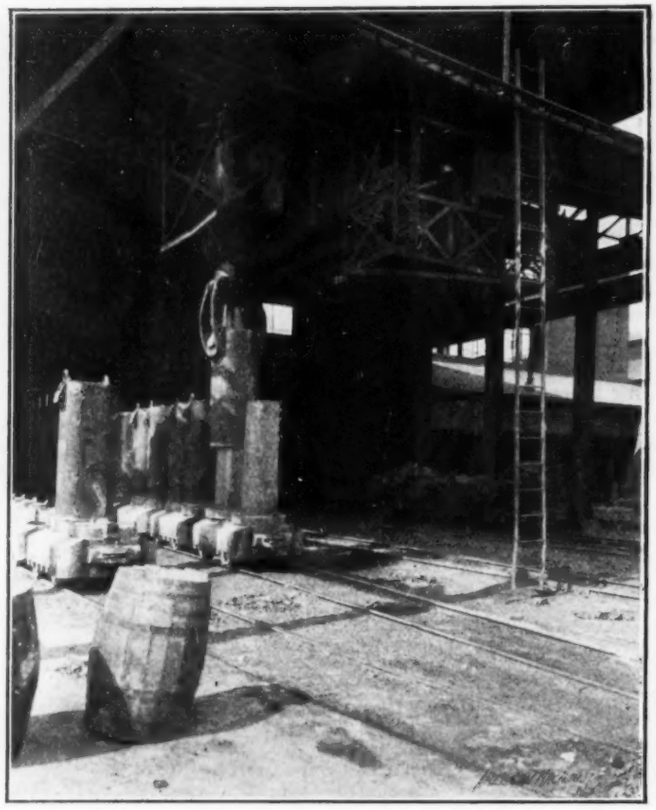


FIG. 3. STRIPPING THE MOLD FROM THE INGOT

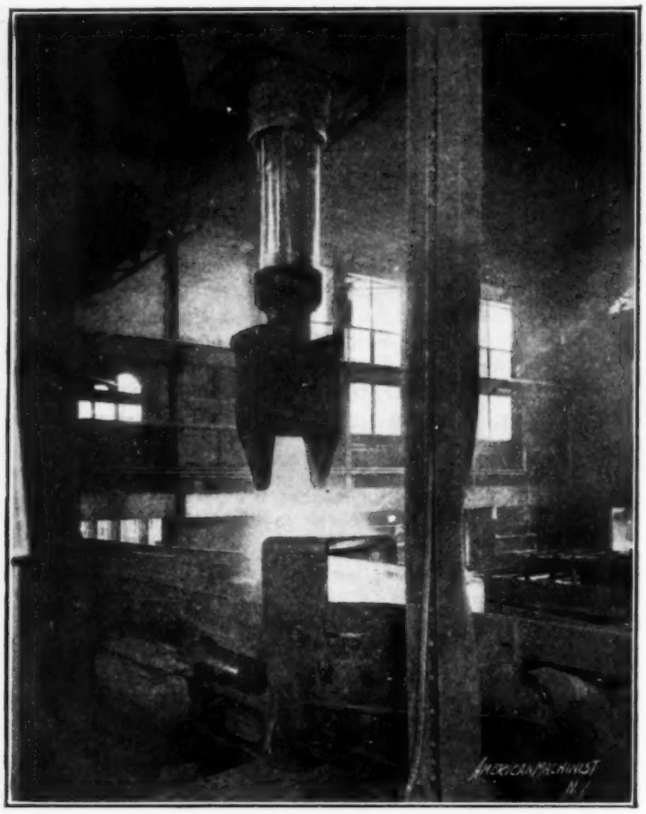


FIG. 4. STARTING TO ROLL THE INGOTS AFTER REHEATING

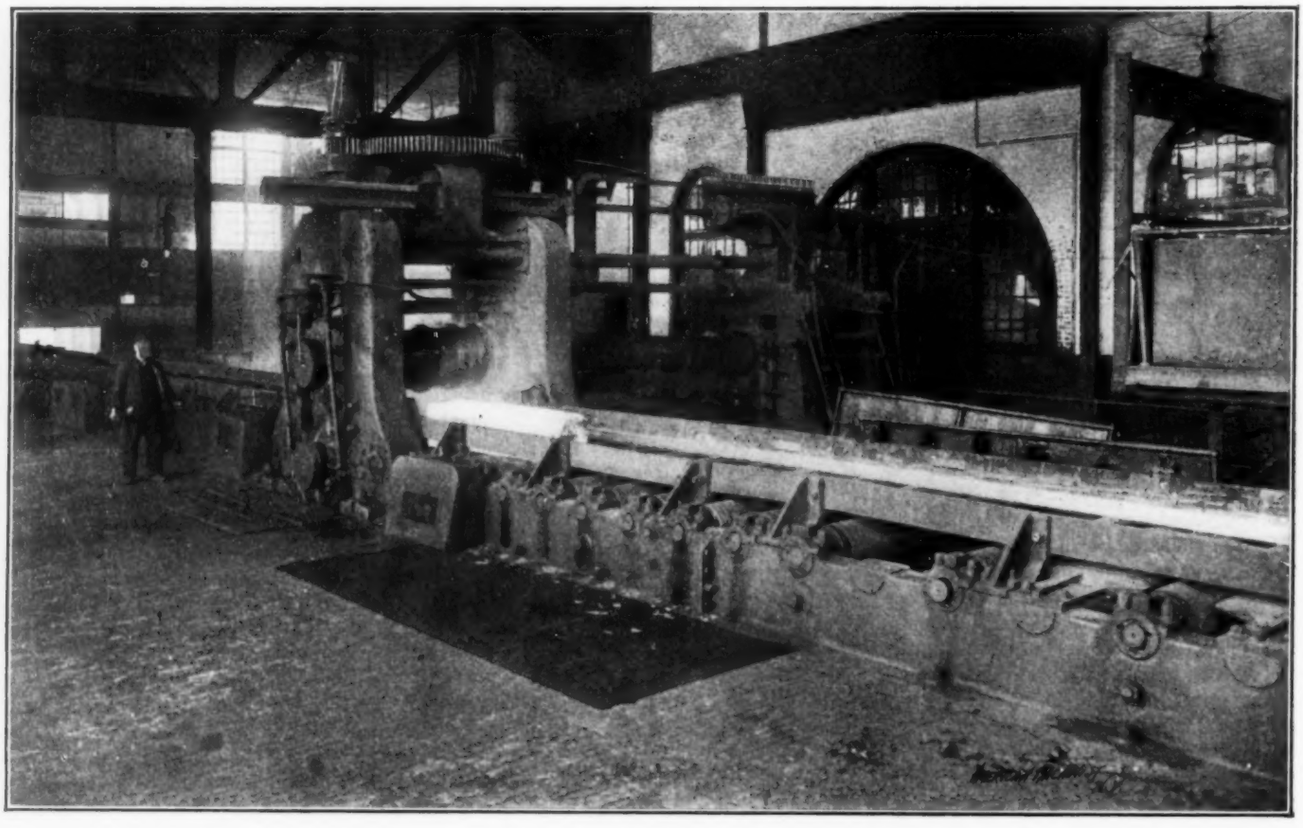


FIG. 5. THE INGOT-ROLLING MILL AT WORK

In the Rod Mills

From here they are again heated and pass through the rolls shown in Fig. 6, the rods being guided by the cast-iron channels or tracks shown in the foreground. These go through the rolls at a very rapid rate, around the curve shown at the extreme left, back through the rolls shown just in front of the danger sign, and back again in the curved track to the long straight runways just in front of the wall and which disappear in the distance.

At the other end of the track are the rolls shown at the right of Fig. 7 through which the hot rods are passing, and from here they are returned to the rolls in front of the right-hand operator with the tongs. As soon as the end sticks through these rolls, he grabs it with his tongs and carries it so as to enter the left-hand set of rolls. In the meantime the rod is running through the first rolls at the rate of about 2500 feet per minute so that it has formed a long, hot, writhing ribbon down the metal incline and it often takes lively work on the part of the men to keep out of its way.

FIG. 7. THE FINISHING ROLLS

Coiling the Rolled Rods

From these rolls it goes back to the coiling machine shown in Fig. 8, there being eight of these in this row. Here the wire is coiled down inside the steel barrel shown, and as soon as the piece has been entirely coiled up, the spool coiling the wire raises up out of the barrel, under control of the operator shown up in the pulpit. These coils are then pulled over into the runway in front of the eight coiling machines and are then slid along by the fingers of the continuously traveling chain which can be seen between the coils. These deliver them to the conveyer operating in the track shown in front, and from here they go to the truck to be carried to the wire-drawing mill, which is the last stage of the process of making plain steel wire.

Drawing the Wire to Size

The coil of wire is dropped over the spool arrangement shown on the floor and the end reduced so as to start through the first hole in the die. There is rather an ingenious arrangement for starting the wire through the dies, which is a sort of mechanical "come-along," such as is largely used by linemen in tightening electric-line wires. In front of the bench can be seen a long bar running over three pulleys. This bar is moved back and forth by arms which come up from the floor and which can be seen to the left of the post. The come-alongs or clamps, one of which is shown lying on top of the bar, are gripped on the end of the wire and the operator couples this on to the constantly moving bar by pressing down on the treadle shown under the right-hand pulley.

Pressing down on one of these treadles

FIG. 6. THE ROD MILL AND ITS TRACKS

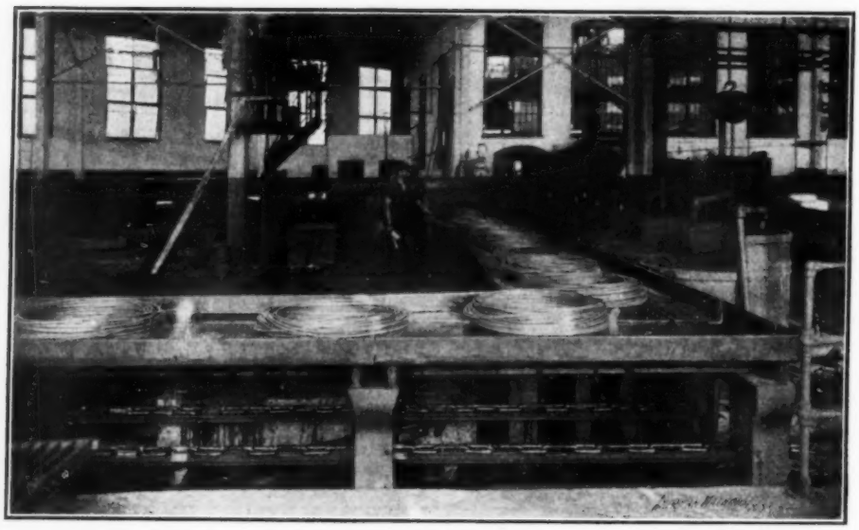


FIG. 8. THE COIL CONVEYER

FIG. 9. THE FINAL DRAWING TO SIZE

engages the "come-along" with the moving bar and gives the power necessary in pulling the wire through the dies a sufficient distance to allow it to be fastened to the block on which it is to be wound. One of these empty blocks can be seen in front of the open window near the post.

Final Drawing To Size Through Dies

The dies consist of chilled cast-iron plates containing a number of holes, one of these dies being shown on the bench over the middle reel. These dies are fastened in the drawing block and the wire drawn through these by power being applied to the revolving blocks on the bench. The holes in the dies vary in size and the wire is drawn through first one hole and then the next until it is reduced to the desired size. It is, of course, necessary to anneal this wire between some of the drawings, the number of annealings depending on the size to which it is to be drawn.

F. H. C.

An Interesting Jig

Special Correspondence

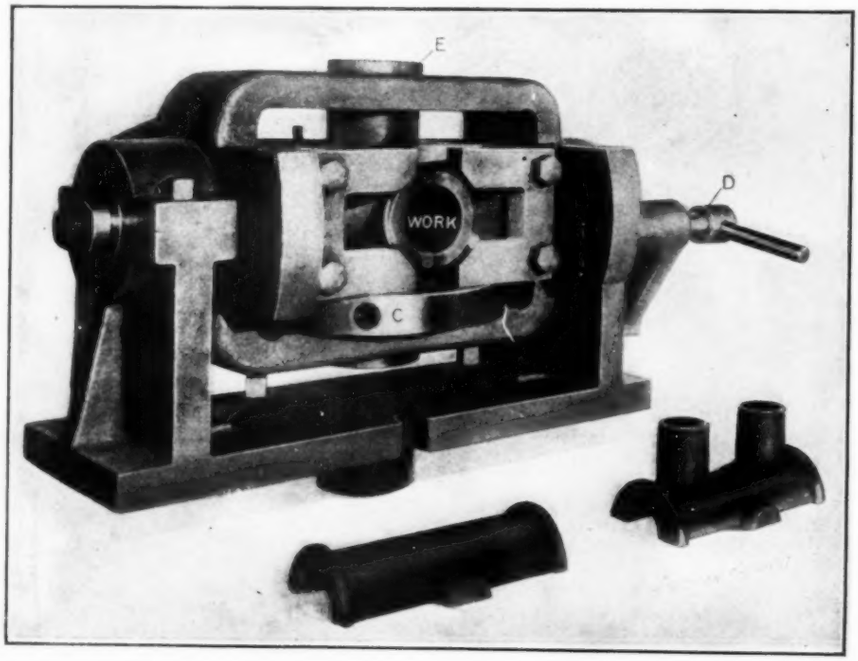
The product of this jig is, generally speaking, not classed with the accurate jig productions, bearing boxes, made in halves, and supported by two side trunnions, and in this particular instance, the efficiency of the boxes relies entirely on the trunnions for lateral adjustment and alinement, which makes it essential that the centers of these trunnions be in a plane with the *bore* of the box, and this places the tool among the accurate reproduction tools.

The Jig

This is self explanatory, practically, and a careful study of the halftone will make plain to the reader the methods of obtaining accurate results. The faces of the box, where they meet, are not machined, simply held against a disk grinder to remove all burs and get a plane surface, one-half of the box is placed in position and held by means of set screws on the side. A flat plate is then slipped into the jig, the one edge of which is absolutely perpendicular to and intersecting the center of the bore of the box, the half casting rests against the face of this flat plate and is clamped in that position. The plate is then removed and the other half-box inserted and the two pieces are clamped by means of V-jaws which are actuated by means of the cam *C*.

The Tools Used

A chucking drill is then run through the castings for roughing, after which a rose reamer follows for finishing to standard shaft size. The whole jig barrel is held



ROTATING JIG

in position by means of a stop pin *D*. After the bore is finished, the stop pin is released and the whole jig is turned through 90 degrees or a quarter turn, and the trunnions are in position for machining. A hollow mill which is guided by means of a hardened and ground bushing *E* machines the trunnion, the jig is then swung halfway round and the opposite trunnion machined.

The general construction of the jig allows for a broader use than this particular piece of work; it is a design that will lend itself readily to a large number of pieces that are being done today in fixed jigs, necessitating several turnings. The designer, Mr. Nutter, of the Carver Cotton Gin Company, of East Bridgewater, Mass., is contemplating converting it into more general practice in their shop.

Some of the Work of the Old Masters

By R. H. Victory

Elsewhere in this issue is given a short sketch of William B. Bement, written by an old friend of his. It is with pleasure

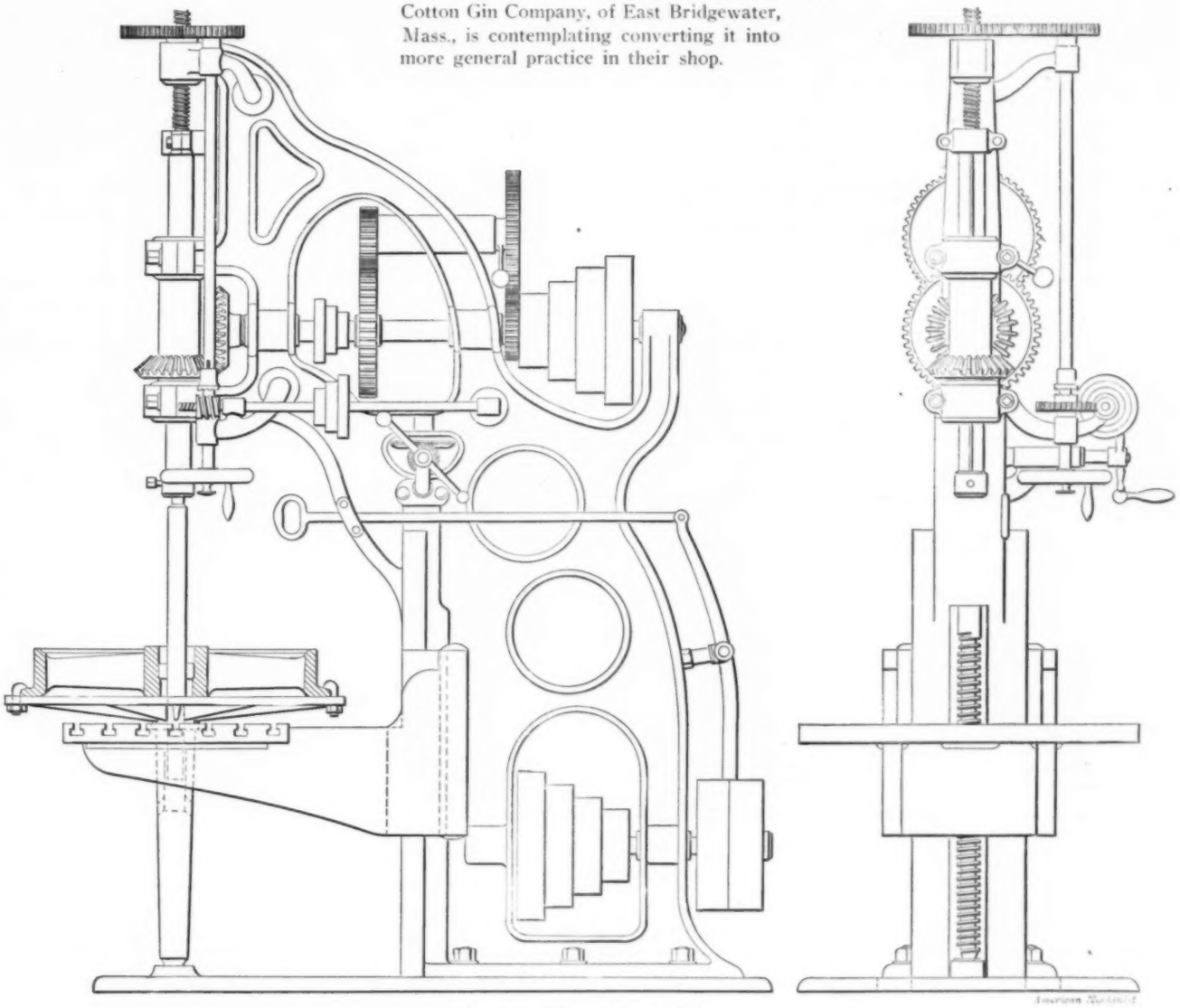


FIG. 1. UPRIGHT DRILL PRESS

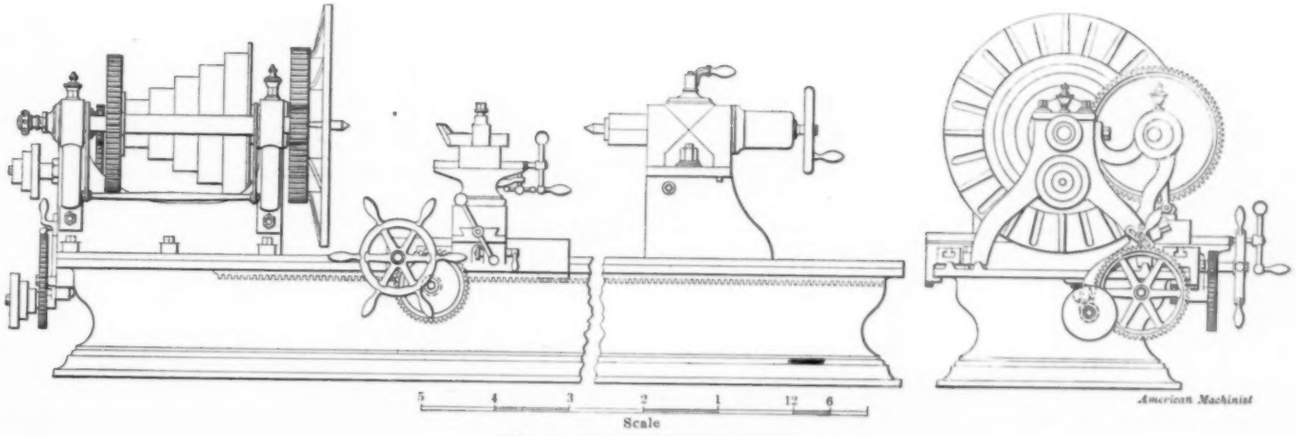


FIG. 2. 50-INCH ENGINE LATHE

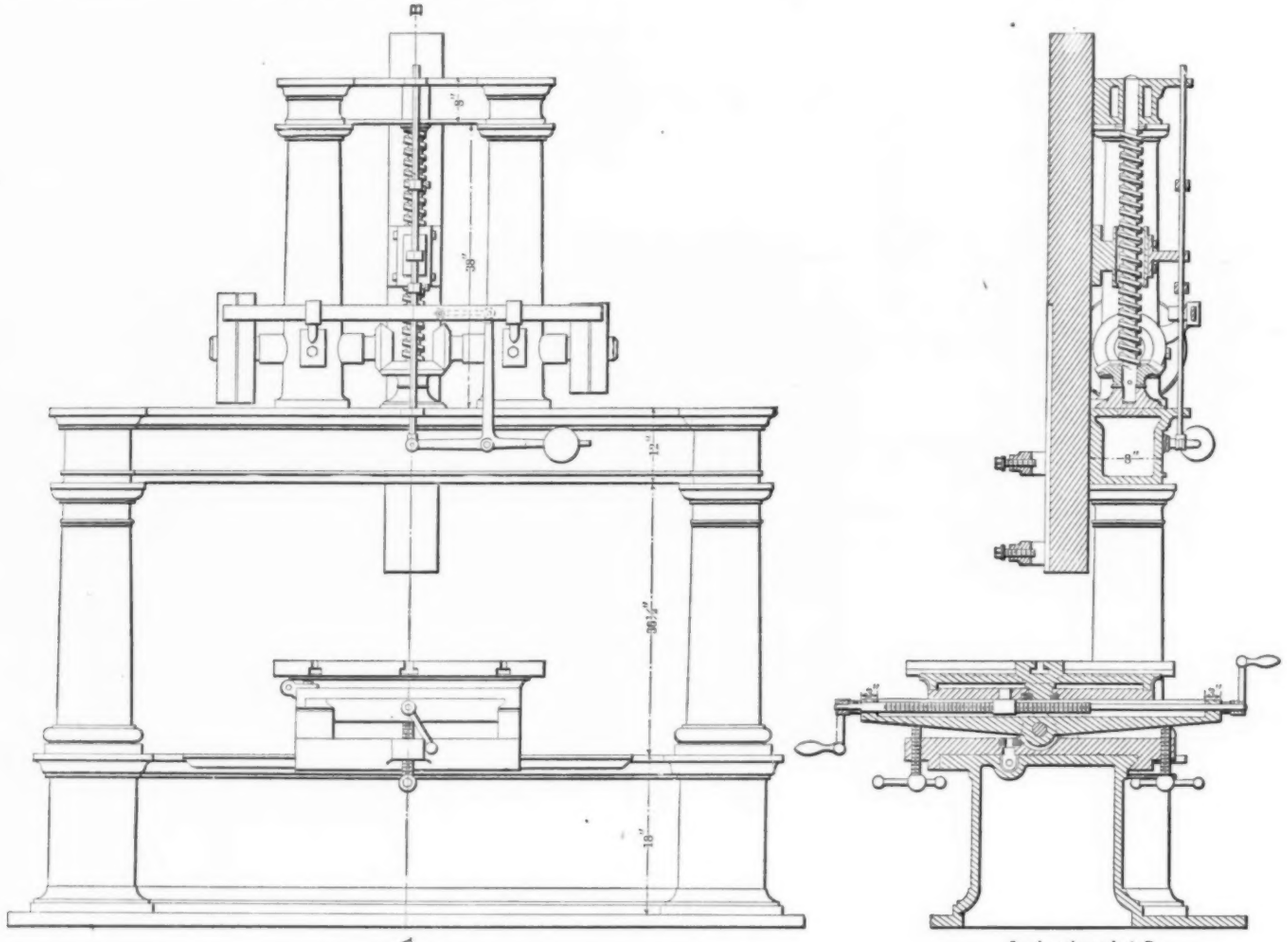
that I herewith show some reproductions of drawings done by the hand of William B. Bement.

The illustrations of machines here shown are selected from a number in the possession of the Lowell Machine Shop.

Fig. 1 shows a drill press of which there were four of various designs, dating from November 25, 1850, to May, 1851. On one of the drawings, which is undated, appears a correction dated December 6, 1858. There is no date on the drawing from which Fig. 1 was reproduced. Fig. 2 shows an engine lathe, which is one of four drawings of lathes, dating from July 11, 1849, to April 17, 1851. One of those not shown gives the details of a 90-inch swing engine lathe with swiveling tailstock with square tail spindle having hand and power feed. Two gap chucking lathes, both drawn by William B. Bement and swinging, respectively, 36 and 60 inches in the gap, are among the lot.

Fig. 3 shows a slotting and paring machine. Of these there are two. The one not shown, of the ordinary crank type, was drawn by William B. Bement and dated October 26, 1850. The usual rotary and other feeds by power are present in this drawing. The one shown, it will be noted, is dated June 21, 1849, has a tilting table for taper work and hand feeds for all the table movements.

Fig. 4 shows the typical William B. Bement horizontal boring and drilling machine. It is, however, dated Lowell Machine shop, 1865, at which time Mr. Bement was in Philadelphia. However, as he was on very friendly terms with many

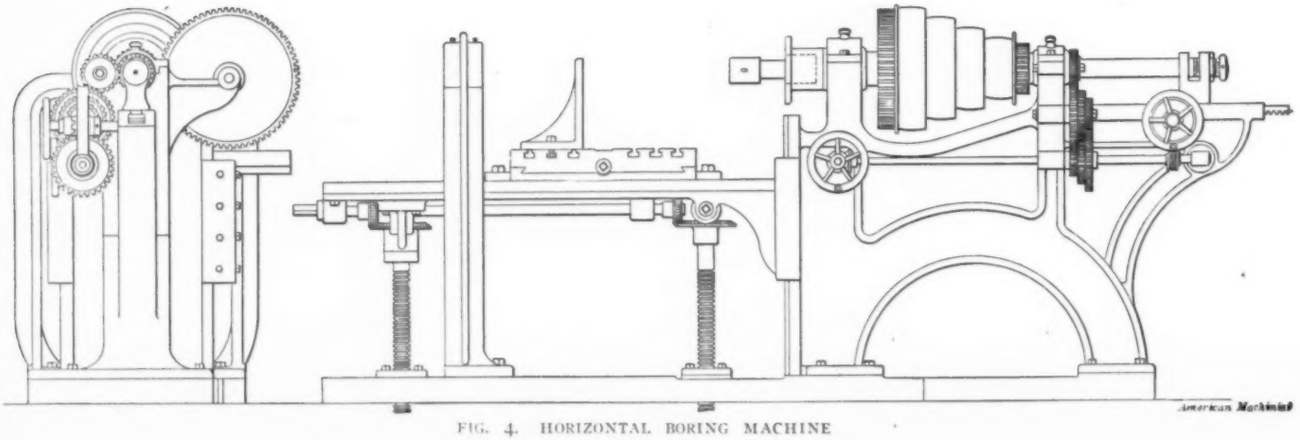


Back Elevation

Section through A-B
Showing Parts Intersected by the
Cutting Plane and Parts beyond.

American Machinist

FIG. 3. SLOTTING AND PARING MACHINE



American Machinist

FIG. 4. HORIZONTAL BORING MACHINE

of the Lowell men, it is probable he made the drawing in Philadelphia and sent it to them. It will be noted that the nest of feed gears to the right has no apparent mechanism for engaging any one of the three lower feed gears. There must have been some such mechanism. This drawing would tend to show that machine-tool building was carried on after 1854 by the Lowell Machine Shop.

The "Old Masters"—William B. Bement

By J. Richards

Sometimes in the forward rush we gain by "looking backward." I have been following the present effort to modify the motions of metal-planing machines and recently received from an English client a drawing of a machine more than 70 years old by Seth Willmarth, of the Charlestown (Mass.) navy yard, also other old references which reminded me of circumstances of what we now call old practice here, and called to mind some of the "old masters," and notably W. B. Bement.

William B. Bement, whose portrait accompanies this article and who will be remembered by many yet living, was a pioneer in machine-tool practice in this country, a broad founder, we may say, whose example contains many lessons of value to us now.

The "Industrial Works" at Philadelphia were, when completed 40 years ago, undoubtedly the best equipped on this Continent devoted to machine-tool making. Their origin and rise would form an interesting bit of history that may at some other time be told, but at present there are only some remarks to be made upon the founder.

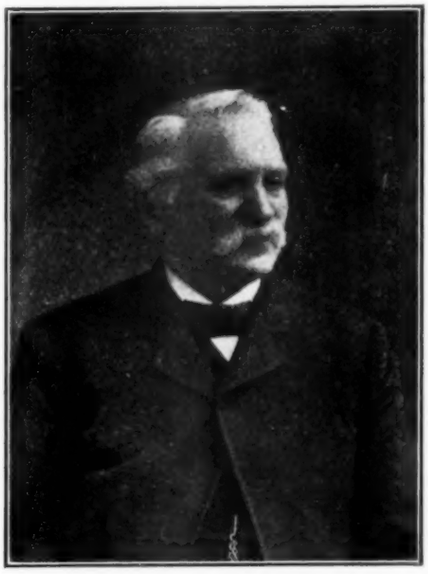
Mr. Bement's name appears in the Lowell, Mass., directory from 1847 to 1851. He was a draftsman in the old Lowell Machine Shop, under that celebrated engineer Uriah Boyden, who introduced the Fourneyron turbine water wheels, more than 60 years ago. These long remained, and indeed, may yet remain, the best example of practice in this country. The drawings were so carefully made that, as Mr. Bement informed me, "the radius of all the fillets were figured."

From this refined practice Mr. Bement was selected to enter an engineering establishment in what was then the extreme West—Wisconsin, I think—and with his young family arrived at the place the next day after the whole works was destroyed by fire.

After various vicissitudes, such as fell to the lot of young engineers at that day, he entered or formed the firm of Marshall, Bement & Colby, in Philadelphia, on the ground where part of the Industrial Works now stands. The original business intended was textile machines, but this was too circumscribed a field for Mr. Bement, who soon led off into machine tools, which had been a branch at the Lowell Machine Shop between the years 1848 and 1854.

He prepared designs for a complete line of tools, following the old architectural form of framing and published a catalog of these machines—the finest that had till then appeared. This did not last long, that is, the architectural and chromatic features did not, and the whole scheme of design was abandoned, the catalogs suppressed and Mr. Bement became a convert to the motto (his own), "Whatever is right looks right," and adopted the plain, logical style of Whitworth in England.

However, one feature of the original practice remained—good fitting and honest work. He always demanded good prices for his machines and got them. I, who



WILLIAM B. BEMENT

am an old pupil of his, went to the works in 1864 to get a small engine lathe, a simple, plain looking tool with screw feed, and was asked $500 for it.

"Is not that a very high price?" I inquired.

"Yes, it is," said Mr. Bement. "We always ask and get high prices; but the price is put into the machine."

He had the lathe partially taken down for inspection. It proved his claim.

Mr. Bement was a taciturn man, who did a deal of thinking on various lines besides "tools," and was the best "prophet" in trade economics I have ever known. His partner, Mr. Dougherty, a learned and skilled foundryman, who went out to Russia with the Winans to assist in building the Moscow & St. Petersburg railway, and afterward served in the Royal Foundry of Bavaria, always deferred to Mr. Bement's forecasts of the future.

In 1873 I heard Mr. Bement say to Mr. Dougherty: "The Industrial Works will earn nothing for three years to come. Set your house in order." It turned out a true prophecy, little dreamed of by others in the business at that time.

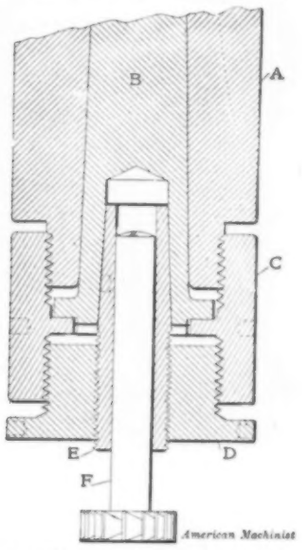
He would walk around for a week or two with some new design in his head, in the meantime setting some of the draftsmen at work on the same thing, but without instructions. Then he would come into the drafting room in the morning, see what they had done, take off his coat, go to work, and in five to eight hours would fill a "double elephant" sheet with a whole machine and all of its details.

Once in San Francisco, where he went to consult over some special machine tools for mining machinery, he amazed the staff at Prescott, Scott & Co.'s (now the Union Iron Works) by designing in a day a huge combination machine with complicated functions. His most remarkable traits were intuition and analysis, but this remark applies to all great masters in the mechanical arts.

A Chuck for T-Slot Mills

By W. Ochse

Having to mill circular T-slots in bottom of shaper vises using a drill press to drive the cutter, we found the chuck shown herewith to work exceptionally



A CHUCK FOR T-SLOT MILLS

well. We are now enabled to complete at least ten times the number of pieces without breaking a single cutter.

The taper sleeve *B* is held in the spindle *A* by the nut *C*. The sleeve *E* has 3 slots milled in it, one going entirely through while the other two go but two-thirds through to allow it to spring together and hold the shank *F* of the cutter when the nut *D* is tightened. The nut *D* is provided with a differential thread which allows the sleeve *E* to be drawn in and ejected. It is seven pitch on the outside and twelve pitch on the inside. A center is also provided for this chuck for setting the work in accurate position.

Ball-bearing Apparatus at Neubabelsberg

The Machinery Used at the Famous Laboratory That Made the Finest Investigations of Ball Bearings Ever Carried Out in the World

BY HENRY HESS*

It may be fairly conceded that no single machine element is of such absolute importance as the journal or bearing in its many varieties; not the busy housewife's sewing machine nor the humble laundry woman's washer, not the workman's dollar Ingersoll nor the plutocrat's thousand dollar Glasshuetter chronometer, not the roughest mining machine nor the finest tool-room grinder, not the farmer's cream separator nor the textile operator's million-multiplied spinning spindle, not the speed-loving land, water or air devotees' motor carriages, nor the majestic "Maureto which means, to a very large degree, avoidance or reduction of friction; never, however, more forcibly than when machines had to be propelled by human effort. When that effort was demanded not from the humble toiler compelled to exchange it for a living, but from the ardent devotee of manly sports, the cry for amelioration was loud and insistent. It was thus not long before the plain or pivot bearings of the early bicycles gave way to the far more efficient ball bearings. Many a man who now takes his ease in his gasolene-propelled auto can remember the

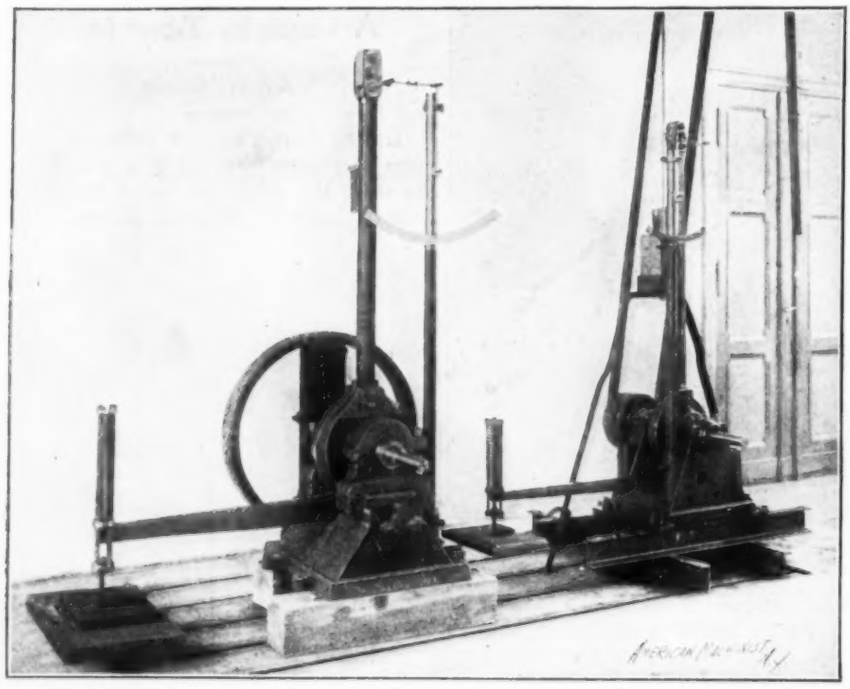


FIG. 1. TWO MACHINES DEVELOPED BY PROFESSOR STRIBECK FOR TESTING THE FRICTION IN BALL BEARINGS

tania's" engines, nor the Empire State's express locomotive, not any one of these could move and perform its allotted tasks should even one of its varied journals fail.

It has never been a serious problem for the mechanical engineer to secure reasonable reliability for all of these journals in their thousandfold variety; but to secure that reliability while wasting as little of useful energy as might be in journal friction always has been, and still is, taxing the highest abilities of this splendid profession's most eminent followers.

Engineers have always recognized and given more or less heed to the desirability of avoiding waste of material resources,

lively satisfaction with which his relieved calves, thighs and back testified most eloquently to the advantage of the ball-bearing over the cone-spindled bicycle.

Whether this improvement originated in England or in the United States is not definite; that the art of making balls of accuracy and at sufficiently low cost was an American development is beyond question. Cleveland may lay claim to being the city of the nativity of this art.

Establishing a Great German Industry

With the efficiency of the ball bearing thus brought home to the entire mechanical world it was but natural that the desire soon grew to extend this advantage to the saving of power, other than that derived from the consumption of food fuels in human organisms. A recognition of the possibilities lying in this almost virgin field caused the D. W. F. (the reader will not object to this abbreviation of Deutsche Waffen und Munitionsfabriken) of Berlin, Germany, to give ear to the proposals of certain American builders of ball-making machinery and to purchase from them its original equipment for the manufacture of balls on a large scale for Europe.

The hope that balls of the medium and larger sizes might be utilized in the manufacture of ball bearings for general machinery of medium and heavy weight was destined to anything but immediate fulfillment. Actual use demonstrated anew

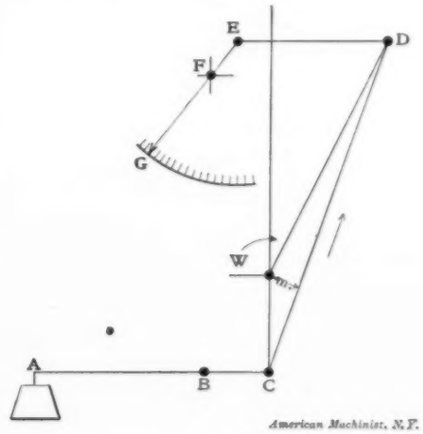


FIG. 2. DIAGRAM ILLUSTRATING ACTION OF BALL-BEARING FRICTION-TESTING MACHINE

an old engineering experience as to the fallacy of reasoning that constructions suitable for light loads were necessarily applicable to heavier ones by a mere increase in dimensions. It was evident ere long that the demands of the bicycle had not developed the inherent defects of its type of ball bearing, but that under its easy demands practically every sin of design could be perpetrated with relative impunity. The fact that a broken bicycle bearing did not mean much more than a spill was not a serious drawback to the individual toughened by taking headers over the handlebars of his high wheeler in encountering the unexpected pebble, or to sliding gracefully rearward to more or less easy contact with mother earth had he preferred to invest in a wheel of the Star variety.

The modern mechanical engineering world, as well as that section of the rest

*President, Hess-Bright Manufacturing Company, Philadelphia, Penn.

of mankind interested in the products of its constructors of machinery, owes a little realized debt of gratitude to the D. W. F. for failing to be discouraged by the losses sustained at this reversal of heavily financed expectations, and for the determination promptly arrived at to develop the inherent principles of correct ball-bearing design.

The Investigation of Ball Bearings

Readers of the American Machinist will recall that the article on page 437 brought a description of what is probably one of the most complete technical investigating laboratories in existence today, that of Neubabelsberg, Germany. As the D. W. F. was one of the founders of this institution it naturally turned to it for aid. After several years of the most painstaking research, combining in a most admirable manner the highly trained theoretical reasoner's methods of investigation with those of the most rigid practical mechanic, to whom nothing appeals except absolutely measurable performance, Professor Stribeck, the renowned head of these laboratories, was able to promulgate those laws and constants on which the whole present art of anti-friction-bearing design and usage is based. While it is not unusual for scientific men to impart freely to the world the results of their labors, a like altruism is not generally characteristic of industrial concerns. It is not one of the least of the D. W. F.'s claims to consideration that it has freely consented to the widest possible dissemination, through reports to engineering societies and the technical press, of these investigations undertaken by and for it at a cost mounting well into the hundreds of thousands of dollars.

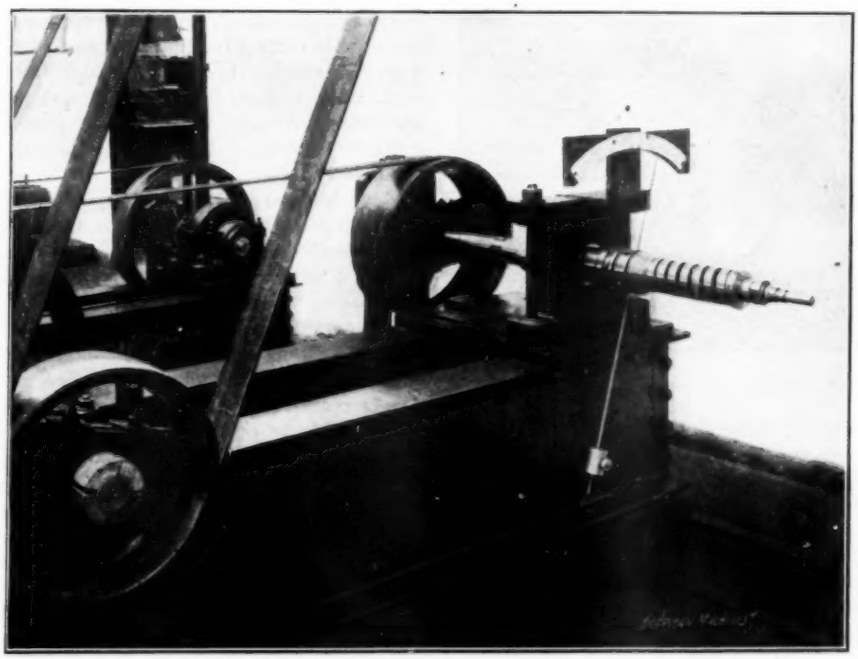


FIG. 3. FRICTION-MEASURING MACHINE FOR THRUST-COLLAR BALL BEARINGS

It is not the purpose of this article to go into these investigations, the results of which are available in English in the Transactions of the American Society of Mechanical Engineers for May, 1907, but rather to call attention to a few of the testing machines used for a continual investigation of the behavior of ball bearings and of the influence of variations in design. The ball bearing is, and always must be, a mechanism that demands the greatest attention to precision in manufacture; a precision probably greater than that of any other machine element turned out in large quantities. This holds not only for the more readily verifiable truth to shape and size, but also for such much more obscure things as hardness, elasticity and toughness and, more particularly still, for a high degree of uniformity in these qualities.

Devices for Controlling Accuracy of Product

The producing mechanic will be interested in the means employed for verifying and controlling truth to shape and dimensions and interchangeability. In the American Machinist, page 21, will be found a very full description of the various appliances used for this control by the Hess-Bright Manufacturing Company, of Philadelphia, which concern is manufacturing the D. W. F. ball bearings in the United States.

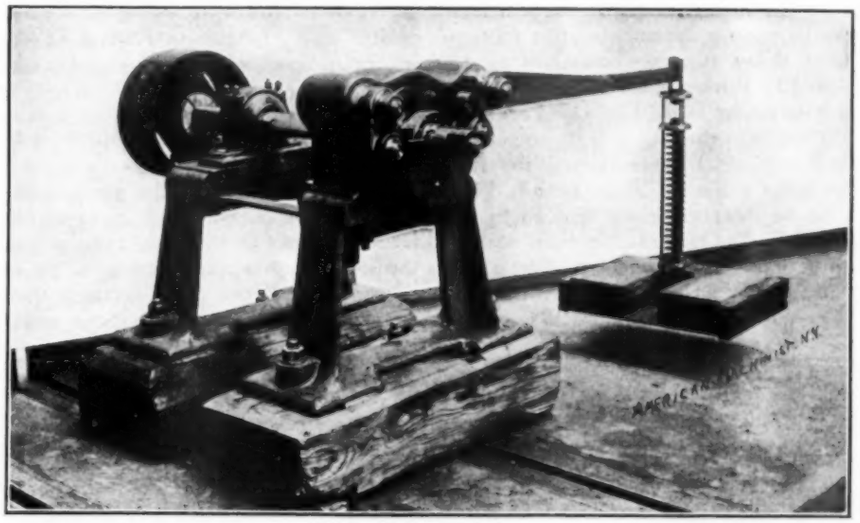


FIG. 4. MACHINE FOR TESTING ENDURANCE OF BALL BEARINGS

While gages and measuring appliances will serve to verify truth to shape and size, and merely have to be carefully adapted to the unusually small tolerances of this manufacture of interchangeable ball bearings, and while the machines and appliances used for determining the physical qualities of the steels employed for these ball bearings are in general more or less familiar to engineers, this cannot be said of the apparatus necessary to determine that the heat treatment and hardening has resulted in uniformity of the finished product.

There are employed regularly, by Hess-Bright as well as the D. W. F., for the determination and comparison with a standard of hardness, various types of apparatus such as: The ball-indentation machine of the Swedish engineer, Brinnell; the diamond scratch machine, due to the Englishman Turner, as well as its modification by our own eminent Howe; and the extremely convenient sclerescope due to the American Shore. Mechanism for the deformation of balls and races and the determination of the limits of elastic and permanent deformation is also regularly employed.

All of these have their own field of usefulness and are indispensable, but the final reference is that to absolute measurement of carrying capacity, endurance and initial friction on special machines devised for daily testing of these qualities on bearings

that are taken at random from every bearing lot that has passed the other inspection.

Ball-bearing Friction-testing Machines By Professor Stribeck

As the friction developed in a bearing is less the more perfect the bearing, it follows that the greater life may be expected from that bearing whose lesser friction indicates its nearer approach to perfection. The first testing machine will logically be one for determining this friction. Fig. 1 shows two such machines as developed by Professor Stribeck, the smaller for a maximum radial load (load acting at right angles to the shaft) of 10,000 pounds, the larger equal to measuring the friction under a load of 20,000 pounds. The action of these machines, that might appropriately be termed "friction scales," will be more readily understood by a reference to the skeleton diagram of Fig. 2.

The unequal armed lever $A\,B\,C$ carries the loading weight at the end A of its longer arm, supports the strut $C\,D$ at the end of its shorter arm, which strut in turn transfers the pull to the bearing through the tension rods $W\,D$. The bearing is carried by a shaft journaled in the main frame and arranged to receive right and left rotation.

With the loading force acting in the direction of connecting line $C\,D$ a rotation with the arrow will cause deflection of the tension rod as indicated; the friction moment of the bearing equals the force P into the lever arm m (m being the distance from P to the axis W), conceiving the friction moment as the product of an ideal friction μP, and its distance r from the shaft axis, gives a balance of forces when $\mu P r = P m$. Since r has a definite value for every bearing μ is proportional to m. The deflection of the tension rod is, therefore, proportional to the bearing-friction coefficient.

The action of the torsional forces due to the weight of the swing $C\,D$ and the tension rods $W\,D$ must be considered. A second swing $E\,F\,G$ of smaller dimensions is introduced to balance their torsional moments. The up-pointing arm is connected by a light strut rod $E\,D$ to $C\,D$, while the down-pointing arm $F\,G$ carries the balance weight. Lever $F\,G$ is also utilized as a pointer in connection with a fixed arc scale. This multiplication of the deflection of the main swing $C\,D$ gives greater ease of accurate reading of the friction, proportional to the greater range of deflection.

Friction Measuring Machine for Ball Thrust Bearings

For ball bearings of the thrust-collar type a friction-measuring machine of different construction is shown in Fig. 4. The thrust bearing whose friction is to be measured is placed on a rotating shaft and loaded by a calibrated spiral spring confined between the bearing and a nut near the shaft end. A rod carrying an adjustable weight is attached to the bearing holder; with everything at rest this rod will hang vertically downward. Rotation of the shaft will carry the bearing with it until the bearing friction and weight just balance each other. A pointer rod directed upward and playing over a fixed arc scale measures the deflection.

A machine for a generally similar purpose, but that will measure the friction effect of a ball bearing loaded not only radially, but in thrust as well—the loads having any desired ratio—is described on page 344, Part 1, of 1909 of the American Machinist. This machine is used and was designed by the Hess-Bright Manufacturing Company, of Philadelphia.

While it may be laid down as fundamental law that the higher the friction in a ball bearing the shorter its life, it does not follow that a low friction necessarily indicates long life; that would hold only when actual trial for a fairly long period had demonstrated that the friction remained constant. An increase in friction would show that the bearing was overloaded. Overload has the same effect in limiting ball-bearing life that it has on the endurance of all things, animate and inanimate.

It is for this reason that endurance running tests are embodied as a continuous and prominent feature of the manufacture of D. W. F. and Hess-Bright ball bearings.

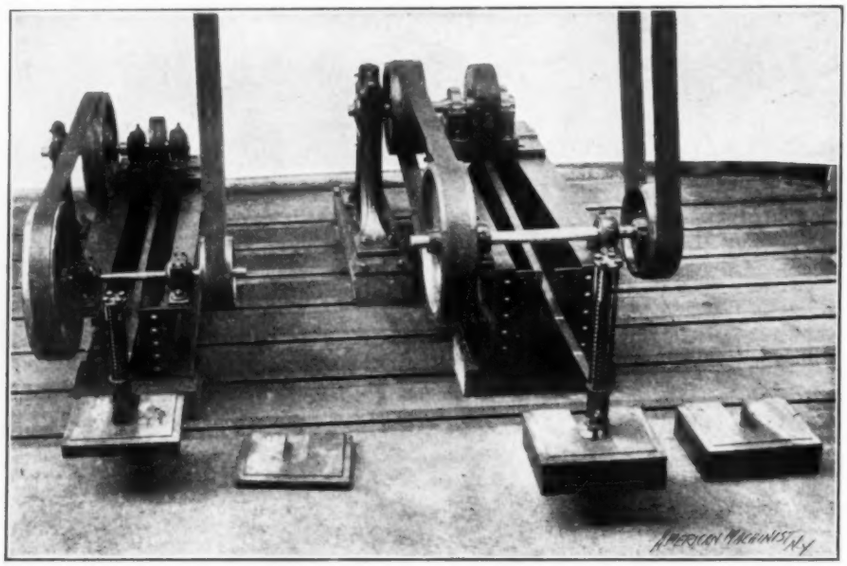


Fig. 5. Two other machines for testing endurance of ball bearings

Machines for the Endurance Testing of Ball Bearings

An endurance machine for radial bearings of the lighter series is shown by Fig. 4. Two similar machines for heavier work are shown in Fig. 5. In these machines the bearing whose endurance is under examination is mounted on a short shaft carried in substantial journals. The simple system of double multiplying levers for loading this bearing is clearly shown, in Fig. 4 particularly. The spring interposed between the suspended weight and the lower end insures a steady loading and the damping out of all vibrations that might be due to the belts, slightly unbalanced pulleys or what not. Variations in speed are readily had by an exchange of the split-wood pulleys.

Incidentally, these endurance machines are used to control the uniformity of bearings. A number taken at random from each lot is run on these machines under extreme conditions; the lot is not passed until these samples show up satisfactorily.

These endurance machines are arranged to give information also on the behavior of bearings under adverse conditions such as improper lubrication, presence of sand and grit in the lubricant, dry running, overloading, the effect of different forms of cages and ball spacers or absence of spacers as well as eccentric loading. For the latter purpose the load is applied not in the central plane of the ball circle, but considerably to one side, so that a tilting action and a pinching of the balls at opposite ends of a diameter result.

Tests of the Balls and Races

Static tests of balls and races are also made on samples taken at random from every lot. Hardness of balls is determined by pressing balls against one another under a load of 500 kilograms per each centimeter of ball diameter squared. That is, a ball whose diameter is 2 centimeters would be subjected to a load proportional to the square of 2, or 4; in this case 2000 kilograms. The resultant mean unit load on the area of compression will be not less than 650 kilograms per square millimeter, or 940,000 pounds per square inch.

The Brinell test for the hardness of the race rings is made by pressing a hardened steel ball against the radial face of a ring under 2000 kilograms per each centimeter

of ball diameter squared. The size of the ball varies with the radial race width; balls employed are either 1 centimeter or ½ centimeter (0.4 or 0.2 inch). The mean unit load on the area of compression should not be less than 600 kilograms per millimeter (852,000 pounds per square inch).

The toughness of balls and races is determined as to the entire body and also as to the outer skin. That load under which the first crack in the compression appears is a measure of the skin toughness. When balls of equal diameter are pressed together it is found that the first crack follows the circumference of the compression area. The corresponding load of hardened, ground and polished steel balls should be 500 kilograms per centimeter of diameter squared, but never less than 300 (6850 and 4110 pounds per inch of ball diameter squared).

The breaking load is the measure of the toughness of the complete ball. When the ball is compressed between two equal balls under uniformly increasing load increments it will be found that good balls will stand not less than 5000 kilograms per centimeter of ball diameter squared. The best value is 8000 (68,500 and 110,000 pounds per inch of ball diameter squared).

The toughness test of the races involves an oval pressing; they must, without breaking, stand a compression that varies with their thickness and diameter.

When balls or races do not come up to the desired values rigorous investigation is made of the materials and of the hardening. Microscopic examination of ground sections, chemical analysis and special annealing and tempering tests are among the methods employed to locate causes of trouble. Examinations such as these are carried out with especial care on all bearings that have proved defective in actual service. Much of the advance is due to the knowledge thus gained of the requirements and effects of service conditions.

The investigations on journal bearings carried out at Neubabelsberg were by no means confined to the ball variety. While it is true that the desire to find the fundamentals of correct ball-bearing design prompted the investigation it was decided with characteristic German thoroughness that fuller knowledge of plain and roller bearings also was necessary. Some of the results of this investigation are to be found in the Transactions of the American Society of Mechanical Engineers, Vol. 28, December 1906.

Experiments on a Drop Hammer

BY YAEKICHI SEKIGUCKI

In machine manufacturing several types of drop hammers are used as indispensable machine tools to produce small articles at a very low expense. The effect of the blow on the metal in these hammers varies with the falling weight and the hight of fall. But even if the product of the weight and the hight of fall is constant, the effect of the blow varies widely according to the increase or decrease of the weight; that is to say, we get a different deformation on the metal with constant energy.

Diameter of test piece in inches. D	Hight of test piece in inches. H	Hight of test piece after compression in inches. H_1	Depression in inches. $S = (H - H_1)$	Hight of fall in feet. h	Weight of tup in pounds. W	Energy expended in foot pounds. $E = \left(Wh + \frac{W.S}{12}\right)$	Velocity of tup at the end of fall in feet per second. $v = \sqrt{2gh}$	Mean resistance of metal in pounds per square inch. f
1.006	1.005	0.861	0.144	2′—0″	734.25	1,477.7	11.3	154,835
1.006	1.005	0.813	0.192	2′—6″	587.4	1,477.9	12.8	116,213
1.006	1.005	0.788	0.217	3′—0″	489.5	1,477.4	13.9	102,478
1.006	1.004	0.785	0.219	3′—6″	419.6	1,476.1	15.0	101,800
1.006	1.005	0.776	0.229	4′—0″	367.1	1,475.5	16.0	92,341
1.006	1.005	0.738	0.267	4′—6″	326.3	1,475.8	17.0	83,441
1.006	1.005	0.733	0.272	5′—0″	296.7	1,475.2	18.0	81,955
1.006	1.003	0.721	0.282	5′—6″	267.0	1,474.8	18.8	79,028

TABLE 1. DATA OF TESTS ON A DROP HAMMER.

To ascertain the effect of the blow of a hammer the following tests were carried out by me during last year. Using an ordinary drop hammer I made several drop tests. In every trial I added several small pieces of lead to the tup, so as to change the falling weight; at the same time the hight of the fall varied inversely with the weight.

The test pieces were taken from a round copper rod and the size of the piece is shown in Fig. 1. Fig. 2 shows the form of the copper piece after compression and S is the amount of depression of the metal. Table 1 shows the results of the tests.

Neglecting the frictional resistance of the hammer, we can easily calculate the mean resistance of the metal.

Let

D = Diameter of test piece in inches.
S = Depression of the metal in inches.
h = Hight of fall in feet.
E = Energy expended in foot-pounds.
f = Mean resistance of metal in pounds per square inch.
t = Time required to stop the tup of the hammer after striking the metal surface (in seconds).
v = Velocity of tup at the point of impact in feet per second.
W = Weight of tup in pounds.

Then we have

$$E = Wh + \frac{WS}{12} \qquad (1)$$

$$f = \frac{E}{\frac{\pi}{4} D^2 \times \frac{S}{12}} \qquad (2)$$

The value of f is the mean resistance of space average, but if we assume that the

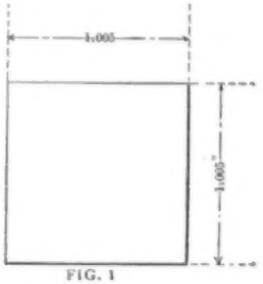


FIG. 1

FIG. 2

American Machinist, N.Y.

FORM OF TEST PIECE USED IN DROP-HAMMER EXPERIMENTS

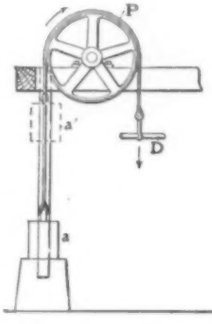


FIG. 3

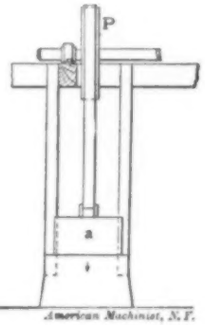


FIG. 4

American Machinist, N.Y.

DIAGRAM OF A DROP PRESS

mean resistance of time average is equal to that of space average we get

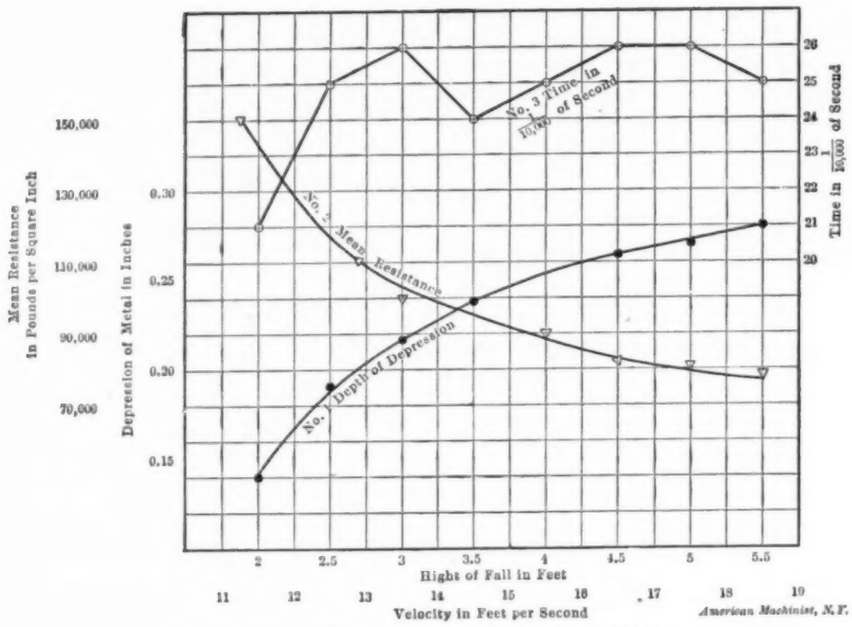
$$\frac{W}{g} v = \frac{\pi}{4} D^2 f \times T \qquad (3)$$

$$v = \sqrt{2gh}$$

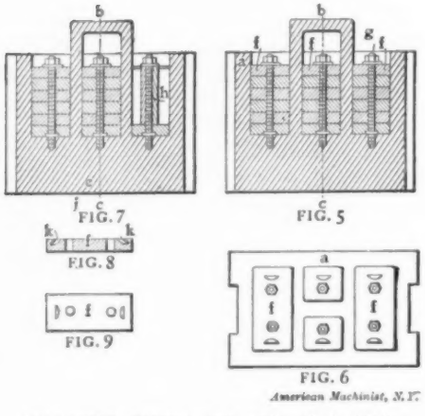
$$t = \frac{W}{g} v \div \frac{\pi}{4} D^2 f \qquad (4)$$

From formula (4) we are able to calculate the time required to stop the tup after the point of impact.

Three curves were traced in Fig. 2. Referring to this figure we see that the mean resistance decreases as the hight of fall increases though the energy expended almost remains constant. The time required to stop the tup does not vary so much. The above result shows that the



CURVES PLOTTED FROM DATA OF DROP-HAMMER TESTS



SUGGESTED DESIGN FOR TRIP OF A DROP HAMMER

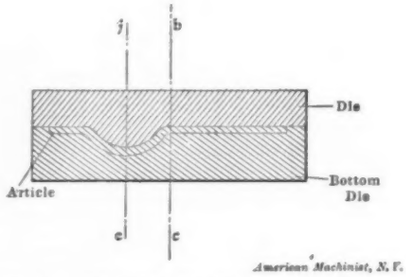


FIG. 10. SECTION OF STAMPING DIES AND WORK

mean resistance of the metal decreases as the rapidity of the blow.

But if the metal is deformed with excessive rapidity it might weaken the strength. So if the strength of deformed metal is out of question, we had better use a small falling weight with a long hight of fall; but in case when the strength of article is necessary, we have to use the reverse.

After these tests were made, I designed a special tup which is able to adjust its weight. Figs. 3 and 4 show the drop hammer of usual form. Figs. 5 and 6 show the section of tup and its plan.

Here *a* is a tup which is made in box shape so as to put a variable weight *f* inside. If we want to decrease the weight take off some of the weight *f* and put the tup at the proper corresponding hight.

By changing the construction of tups as above described, we can always use the hammer to its full efficiency.

Figs. 8 and 9 show a section of the weight *f*.

Sometimes it is required to stamp an article where shape is not uniform; in such a case it is necessary to bring the center of gravity of the tup to the center of deformation. For instance, in case we wish to stamp the article shown in Fig. 10, we bring the center of gravity of the tup to the line *e j* instead of *b c*. This is easily done in the tup above described.

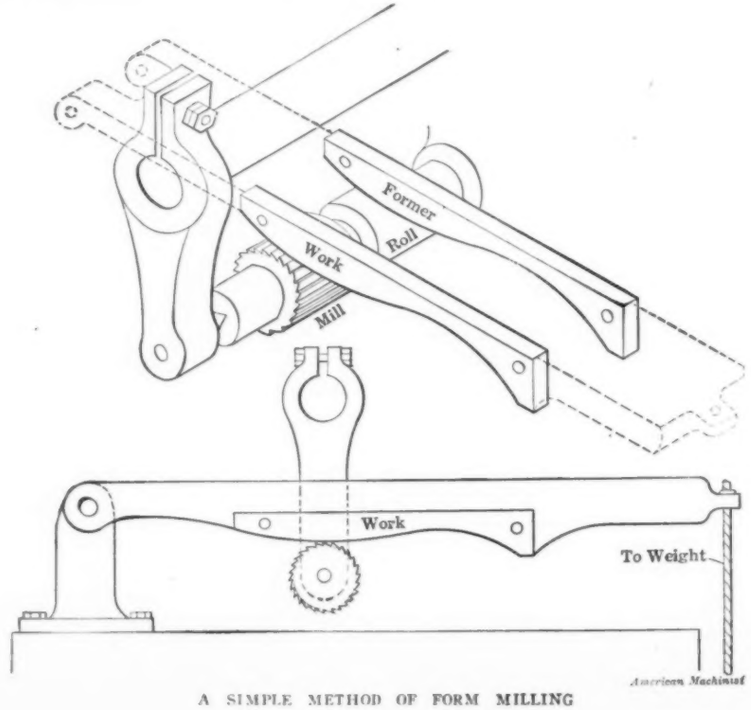
Fig. 7 shows the tup in which a part of the weight is replaced with a wooden block *h;* the center of gravity is removed from the line *b c* to *e j* which is the required position.

I think the construction of hammer tup above described will be useful for drop hammers or drop presses that are used for stamping purposes.

A Simple Method of Form Milling

A very simple and effective method of milling irregular forms on a plain milling machine is illustrated in the accompanying sketch. The lower view shows the fixture applied to the end of the milling-machine table, and carrying the long support for the work, and the former as well as the arm by which this is held down on both the driving roll and milling cutter.

The upper view shows the vital parts of the device in perspective, with the work and the former in their relative position on the supporting arm. Both the roll and the former are of hardened steel and it is easy to see how the regular feed of the milling-machine table carries the former over the roll, which is of the same diameter as the milling cutter, and raises and lowers the work so that the milling cutter leaves it an exact duplicate of the former. This is a very simple device and one that can be used in many places. It was seen in the shop of the Brown Cotton Gin Company, New London, Conn.



A SIMPLE METHOD OF FORM MILLING

A Serviceable Hight Gage

By Ira L. Cole

Some time ago I was called upon to lay out a large number of gear cases for newly designed machinery. I had only begun this work when I discovered that I

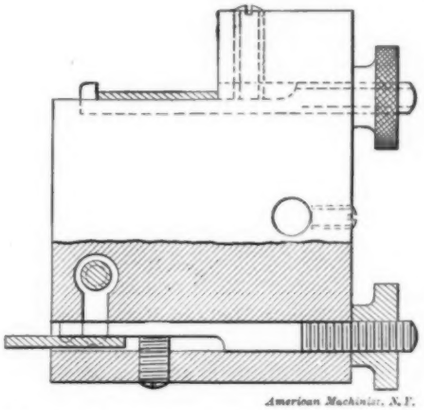


FIG. 1. PLAN OF A HIGHT-GAGE BASE WITH PARTIAL SECTION

had no suitable hight gage, nor could I buy one on the market that filled the needed requirements. These requirements were a heavy, substantial base capable of holding a slotted scale in a vertical position, and having the clamping device high enough to admit of 1-inch vertical adjustment; to this must be added a screw attachment for fine vertical adjustment, also an attachment for carrying a reading glass capable of being set at any level and adjusted to secure focus. To secure the greatest efficiency the reading glass must be mounted in such a manner that a simple motion of the hand is sufficient to move it into any desired position. The engravings show the attachments devised to meet these requirements, and their uses.

The base is provided with seats for holding two scales at the same time. The main scale seat only (the one for holding the slotted scale) is equipped with an adjusting screw to facilitate fine vertical adjustments of the scale. The front edge of this scale projects beyond the base and presents a clear unobstructed edge that may be used as a square, or may be brought against the finished face of a casting and used in connection with the reading glass to ascertain the correctness of the location of one or more horizontal lines upon the face of the casting. The accuracy of the location of gear centers can be tested in this way.

Some Advantages of the Gage

Before taking up the construction of the device I wish to call attention to the advantage of the full inch vertical adjustment, also that of being able to use two scales at the same time.

Nearly all drawings are arranged to show secondary dimensions dating from a center line passing through some main bearing. The location of this center line on the casting is determined by the center of a boss. In practice, to use the device, find the center of the boss in question with the needle of the surface gage, then bring the needle as set to the scale, and raise the scale until an inch division thereon coincides with the needle as set. Note that the arm supporting the glass leaves both hands free for setting the surface gage. To secure this result it will never be necessary to raise the scale more than an inch, but it may be necessary to raise the scale as much as 0.999 inch, hence the provision for a full inch vertical adjustment.

Now, with a center line, as described on the drawing, at an inch division on the scale: To determine the hight of any position on the casting, which is shown to be a number of inches and a fraction above or below the center line, is only a mental operation performed readily and with slight danger of error.

Very often the dimensions shown on the drawing date from two center lines; in this case one scale can be used in locating one set of details and the other scale set and used in locating the set of positions dating from the other center line.

The slotted scale I use is graduated in hundredths and sixty-fourths on the front side; by use of the glass I am able to estimate any number of thousandths very accurately. As a test I have set the surface gage for an odd number of thousandths, drawn a line, then changed the gage, reset the gage to the scale and traced the line so closely that the naked eye could not detect an error.

Construction of the Device

The sketch, Fig. 1, shows a top view or plan of the base, with a section through the center of the clamping screw for the slotted scale. Sections of the two scales are shown. Also a section through the bolt which affects the vertical adjustment.

The base is 1¼ inches high, with clamping screw located ⅜ inch from the top to allow 1 inch vertical adjustment of scale. The plan shows the base about two-thirds original size, the shape of the base being somewhat dependent upon the form of the piece of stock I chanced to find at the time the tool was made. The method of clamping the scales being shown, requires no discussion.

The reading glass is supported, as in Figs. 2 and 3, by a rod which passes through the base, which rod is held by a set screw. This is so placed that the jointed arm carrying the glass can be swung either way around, bringing the glass in front of either scale. One end of this arm is attached to a spool which passes over the rod. The weight of the arm and glass acting on one side cocks the spool sufficiently to hold it in place, though the spool slides freely on the rod. Through the opposite end of the arm passes a stud upon which the glass is mounted.

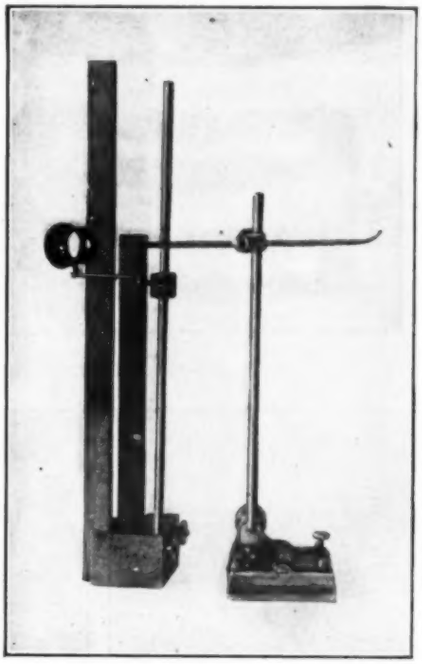


FIG. 2 A SERVICEABLE HIGHT GAGE

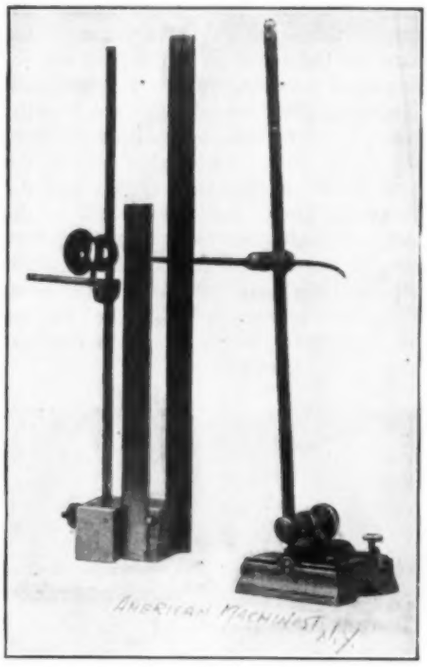


FIG. 3

The halftone, Fig. 2, is from a photograph which shows the base in the position presenting the slotted scale to the front, with the middle of the gage in a horizontal position; its point presented to the scale ready for setting, and the glass at the same hight in front of it. In this position the needle can be set with the greatest degree of accuracy.

Fig. 3 shows the opposite side of the base with the other scale presented to the gage and the jointed arm reversed to bring the glass to bear on the scale.

In a Modern Locomotive Shop

A Few of the Interesting Machines, Operations and Devices used at the Schenectady Works of the American Locomotive Company

BY FRED H. COLVIN

There are few classes of work in which heavier cuts and faster speeds are taken than in the building of locomotives. In this connection some of the methods in use at the Schenectady Works of the American Locomotive Company, and shown in the accompanying illustrations, are sure to be of interest to anyone connected with the modern machine shop.

In the making of the links as shown in Figs. 1, 2 and 3, several stages are necessary. These links are for use in connection with the Walschaert valve motion, connection being made at the top and bottom, which explains the absence of the ears for the eccentric rods as we are accustomed to seeing on the regular links. Beginning at the top of Fig. 1, we have the rough blank or slab just as it comes from the forge shop. Next below this is the pawl blank, having been planed and the two holes bored, marking the end of the slot. It then goes to the slotter which squares out the ends as seen in the third view and also cuts a narrow channel along the center of the slot as a relief for the milling cutter, which completes the machining as seen in Fig. 2.

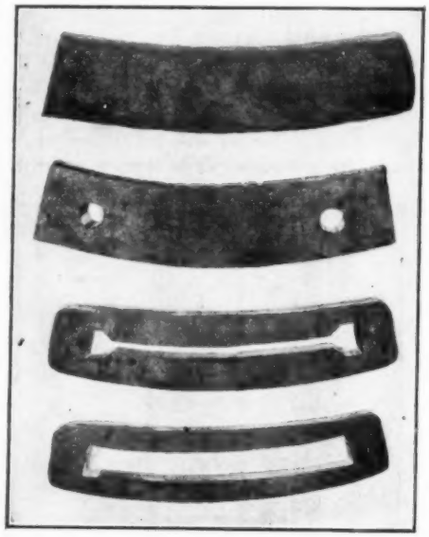


FIG. 1. FOUR STAGES OF MAKING A LINK

found advisable to mill the links out of the solid, inasmuch as too many cutters broke as a result of that method. They are roughed out at about 1 3/16 inches very substantial arrangement, it being one of the many railroad tools built by the Newton Machine Tool Works.

Returning again to Fig. 1, we see the completed link so far as the milling of the slot is concerned, in the lower view, and after being case-hardened, these are finally finished by a grinding on the radius grinder shown in Fig. 3, which is made by the M. C. Hammett Company for this purpose.

A Tough Milling Proposition

Fig. 4 shows another very interesting milling operation in which a long spiral fluted milling cutter is used to cut out the end of a side rod for a consolidation engine from the solid forging.

The milling cutter is about 1¾ inches in diameter and 10 inches long on the fluted portion and it is somewhat startling to see this cutting its way into the solid steel forging of the size shown. These were first used without any support at the bottom, the support being introduced to overcome part of the heavy side strain on the milling cutters. As a matter of fact, the support is more apparent than real as

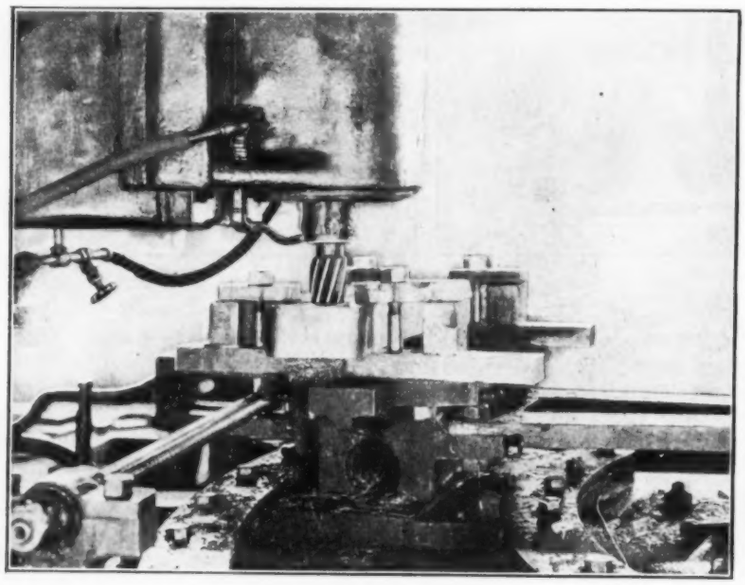


FIG. 2. MILLING OUT THE LINK SLOT

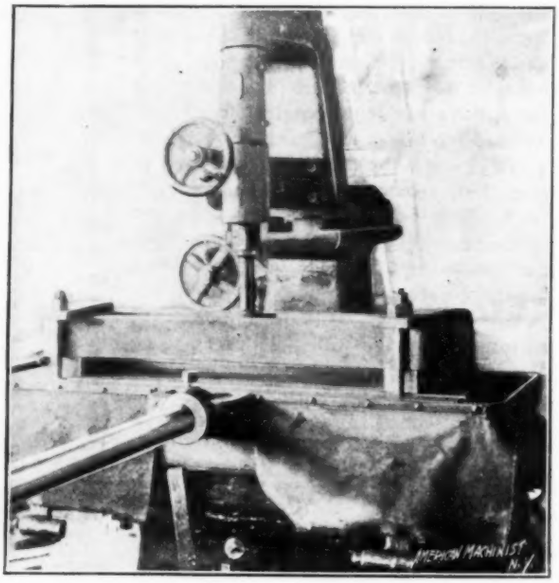


FIG. 3. GRINDING AFTER CASE-HARDENING

Milling and Grinding

A very substantial cutter is used, about the size of the holes bored in the second view, and a close inspection of Fig. 2 will show how the link is held and the way in which it is carried past the milling cutter by the substantial saddle, guided by the curved ways underneath. It was not

roughing cut and a finishing cut of 6¼ inches is taken at 90 revolutions per minute. To the saddle is bolted the radius bar on the right and at the left can be seen the feed screw which carries the saddle and the work past the milling cutter. As will be noted from the spindle of the milling machine, this is a

it is almost impossible to keep the chips out of the bronze bushing in the end of the supporting arm, which means that the bushing cuts out very rapidly and fails to be much of a support to the cutter. It does, however, prevent the cutter creeping in starting the cut. Two feeds are used, 1¼ inches per minute for the rough and

4 inches per minute for finishing. The cutter is run at a speed of 68 revolutions per minute.

Making Shackle Bar Ends

Out in the forge shop is an interesting little machine for making shackle-bar ends for bracing the inside of boiler heads. Fig. 5, 6 and 7 show this machine in various stages of its work, the bar having been just put in place in Fig. 5, the head partly completed in Fig. 6, while Fig. 7 shows the completed loop and the carrier returning to place to be ready for the next piece. A completed shackle is shown in Fig. 8 which consists of two of these eyes or loops with the ends welded together, ready to be again welded to the end of the brace.

Some Interesting Guide Work

In order to insure the ends of the guides being squared up at exactly right angles to their center line, the arrangement shown in Fig. 9 is resorted to. A centering block carrying a deep center, is clamped between the guides at each end, being located by the holes drilled in the end of the guide for fastening them to the back cylinder head and the guide yoke. After being clamped in place by the strap shown the whole piece is placed in the lathe between two centers and the ends squared up to the exact length desired.

This has been found much more satisfactory than squaring up in any other way, such as by milling the ends as is sometimes done.

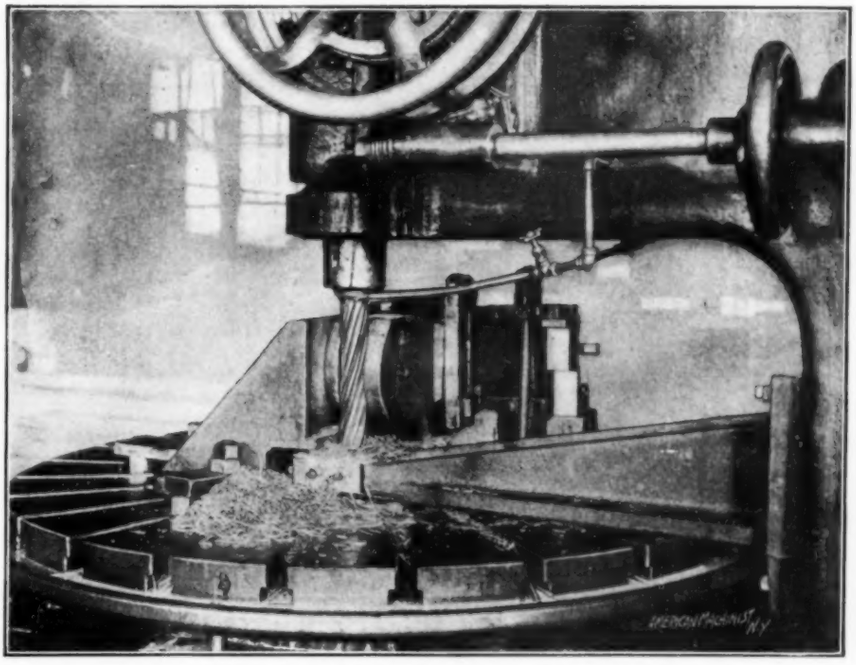
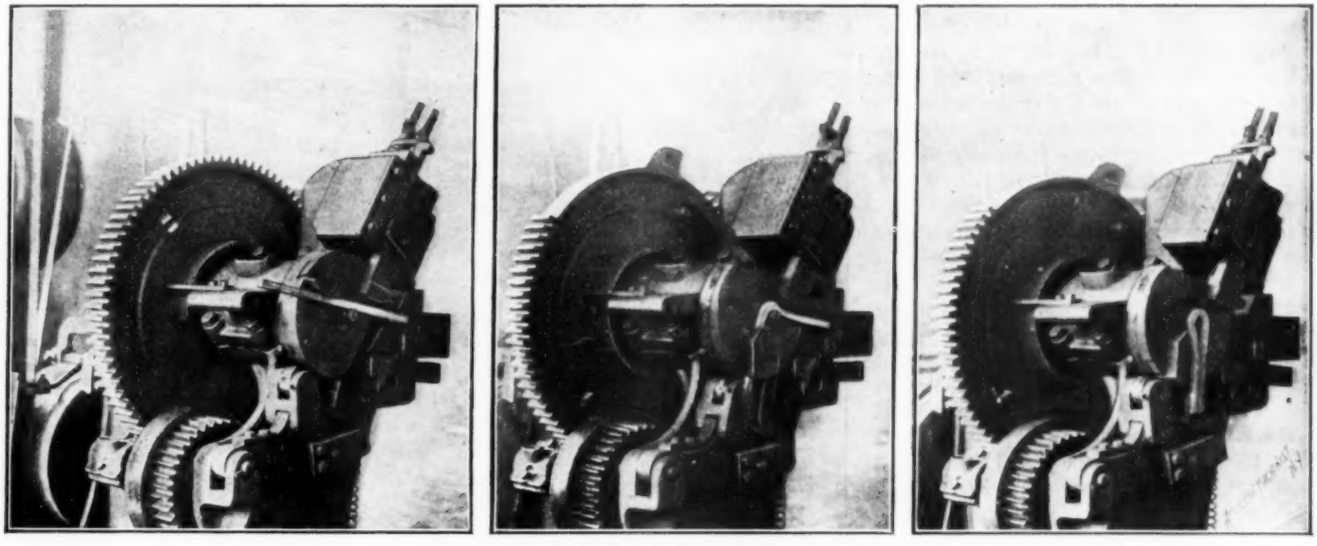


FIG. 4. MILLING ENDS OF SIDE RODS FROM THE SOLID



FIGS. 5, 6, 7. BENDING AN EYE FOR SHACKLE BAR

FIG. 8. A COMPLETE SHACKLE WELDED

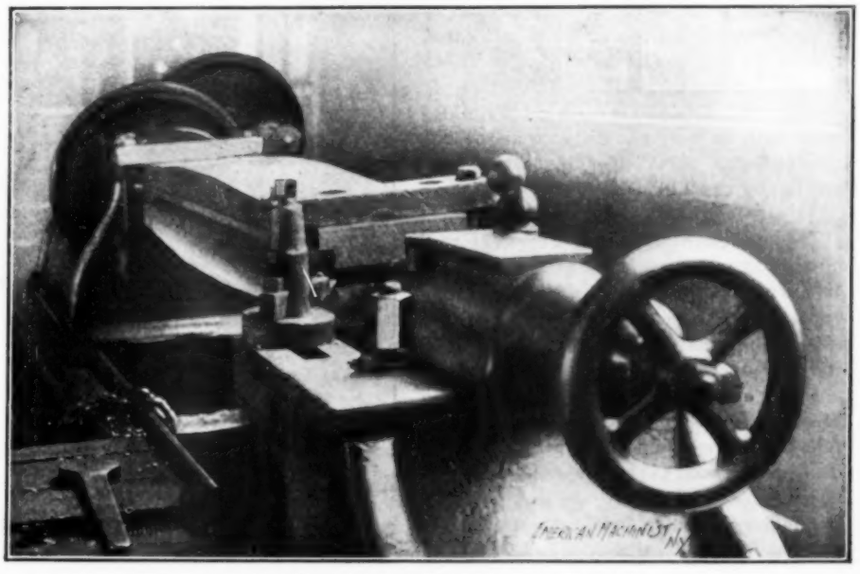


FIG. 9. SQUARING THE ENDS OF THE GUIDES

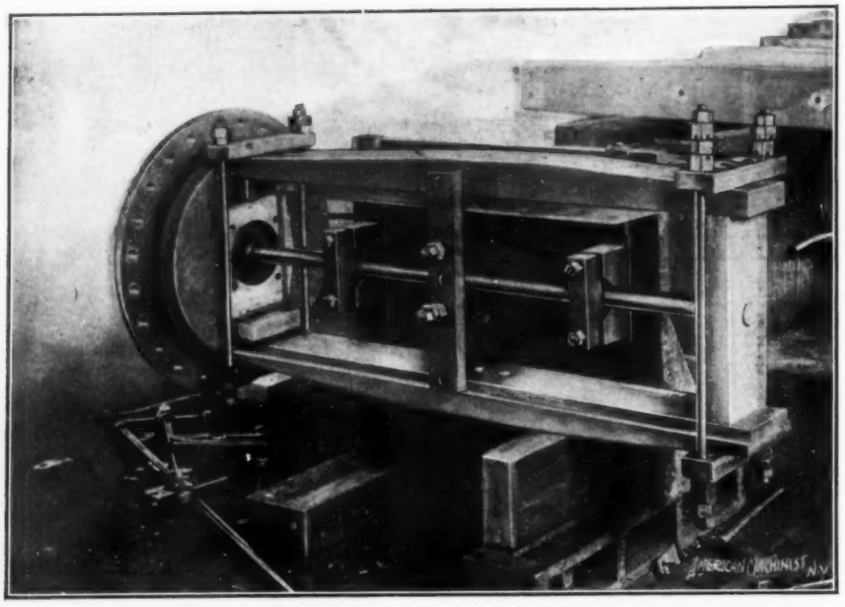


FIG. 10. CENTERING THE GUIDES

Centering the Guides

The device shown in Fig. 10, which we understand originated in the Dunkirk shops of the same company, is for centering the guides with relation to the back cylinder head to which they are bolted.

There is really very little to explain, the main part of the fixture consisting of two floor plates on which is fastened a substantial angle plate carrying a pair of V-blocks which serve to hold at the center a rod which represents the piston rod in actual practice. At the upper part of this angle plate is a projecting shelf on which the upper guide is laid and the centering rod is clamped in the V-block shown at the correct distance from the upper guide.

A split bushing is put in the opening of the back cylinder head which centers this on the large end of the centering rod and a block is put on the other end of the rod to act as a distance-piece, corresponding to the guide lugs or brackets projecting from the back cylinder. In this way the upper and lower guide can be readily lined up from the centering bar at the hole located on the lugs of the cylinder head. These are drilled in while the whole thing is clamped together and insures proper alinement both as to center distance at the position of the guide sideways, when they are finally assembled.

The United States Civil Service Commission announces an examination on January 12, 1910, to secure eligibles from which to make certification to fill vacancies as they may occur in the position of engineer-physicist, or associate engineer-physicist, in the Bureau of Standards. It is desired to secure persons who are fully able to initiate and carry on independent research in the field of engineering physics.

Applicants should apply to the Commission for form 1312.

Drawing and Folding Die Combined

By W. J. Kaup

All tool making is interesting to the skilled mechanic. The simplest form of blanking die makes its appeal from the economic point, rather than from the machine design of the tools, yet throughout the constantly changing demand for cheaper and more accurate production, there is coupled with it, a demand for simplicity in design, which is after all the toolmaker's ideal, perfection; and the goal he is seeking, daily, is not to be able to produce work, irrespective of the number of operations, but to turn out the finished product with the fewest number of re-handlings.

This has always been more or less of a problem in drawing-die design and for reasons which every toolmaker has at some time or other contended with,

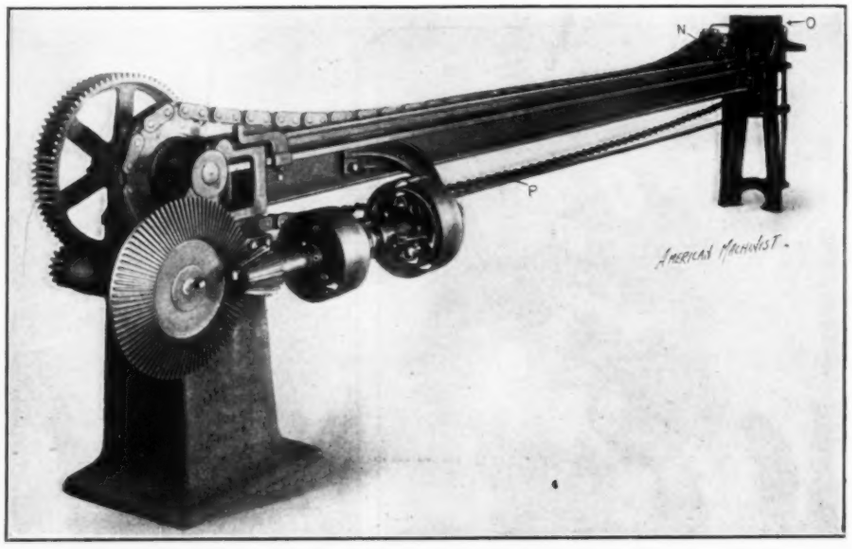


FIG. 1. DRAW BENCH FOR SHADE ROLLERS

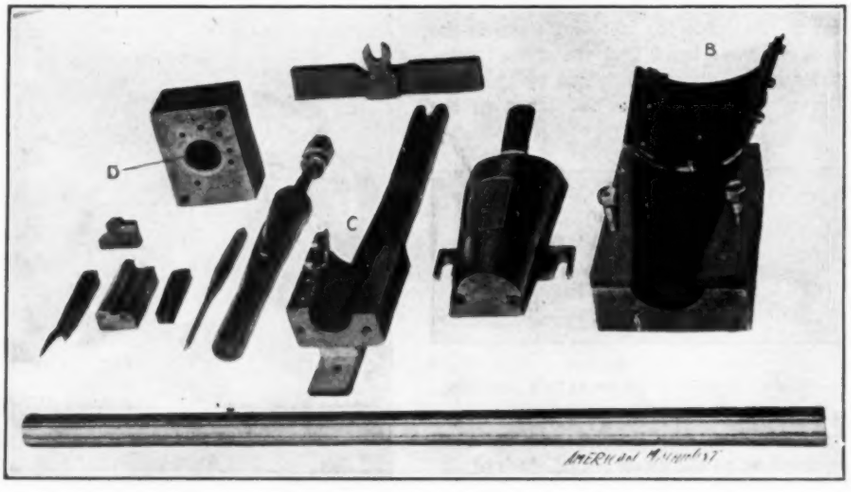


FIG. 2. DETAILS OF FORMING TOOLS
B, first; *C*, second; *D*, finish.

namely, crimping. The great number of extremely interesting examples of drawn work would indicate that the toolmaker's best thought was concentrated along these lines. The machine here illustrated has just been completed by the V & O Press Company, of Glendale, Long Island, and is interesting from both standpoints, economy and simplicity.

The Machine

It is a draw bench for making window-shade rollers, that draws from the flat sheet at one end of the die, to the finished product or roller, at the other end, in any length up to 20 feet and diameter up to 1⅛ inches.

The machine as shown in Fig. 1 is belt driven by straight and cross belts for purposes of reversing, through bevel gears and through train of gearing into the bull wheel, which is attached to the main shaft and drives the sprocket and chain. One end of the top chain is attached to a rolling carriage as shown at *N* and on this carriage are attached the fingers, which grip the steel when it is first fed into the dies, gripping both inside and outside, and drawing the sheet through the whole set of forming dies. The carriage rides on the ways of the machine and acts as a guide for centralization of pull, and travels the whole length of the bed, or any part of it according to the length of tube required.

The small chain *P*, as shown at the bottom of the machine is simply used for returning the finger carriage, hence does not require much pulling strength.

Position of the Dies

On the front of the machine, at *O*, is clamped the series of dies, the centers of which are in a plane with the chain pull of the machine, thereby eliminating any possibility of bending the drawn tube.

The Dies

The dies in position in front of the machine, Fig. 1, are not very clear, but Fig. 2 gives a very clear conception of the detail construction. In this illustration they are not assembled, and the index letters clearly show the different operations which the material goes through. The upper portion of Fig. 3 shows the built up dies and method of building up and holding, while the lower part shows the partially formed sheet, one end completed and the other end the raw product.

Fig. 4 illustrates the form of bend, showing intricacy of the forming and the spring for holding the shade, and will be appreciated by all toolmakers as a good job.

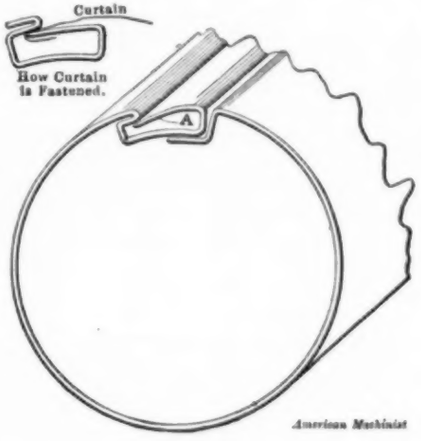


FIG. 4. END VIEW SHOWING INTRICATE BENDS
A, spring which holds curtain

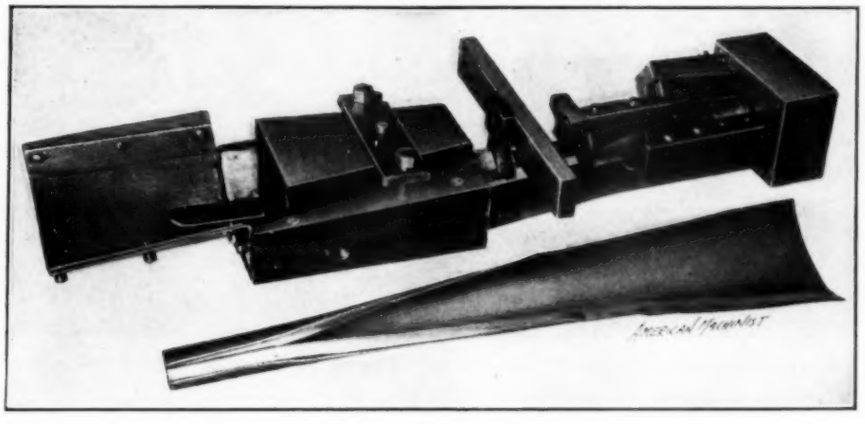


FIG. 3. ASSEMBLY OF FORMING TOOLS

Brazing Cast Iron

By George Tyro

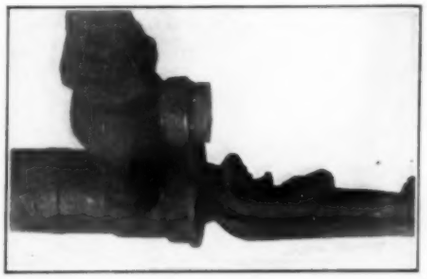
There is an informal technical meeting held in our shop, down at the machine end, almost every noon after the lunch boxes have been emptied and the pipes fired up. The subjects discussed are usually work that is going on in the shop.

We have had a number of motor frames to fix lately, of the old pedestal-bearing type, in which the pedestal had become broken from the base. Our usual mode of repair is to rivet straps and plates on the inside of the casting, but the Old Man decided to try brazing, and Andy, who is an experienced hand with iron and steel, was delegated to make the attempt. Some brazing compound that was said to be the proper dope was procured and—Andy fell down flat on the job.

Nearly all the Solons at the next meeting had experiences to relate, all of a more or less disastrous nature. And while it was generally conceded that the brazing of cast iron was a commercial success, it was also the opinion that there was a trade secret connected with the process that precluded a successful job by an amateur. The Scribe, however, differed, and related an experience that brought forth such a storm of incredulity that, to rescue his fair name from a place on the roll of the Annanias Club he was compelled to produce the accompanying picture.

This job was done some 10 years ago. A little shop was rigged up at home in which I tinkered at odd moments, and being greatly interested in bicycle brazing at the time, when the cistern pump suddenly lost its head I at once decided to braze it on.

The cylinder head, carrying the gland and lever bracket, was formerly attached by means of a threaded rim, which broke off. The lever and packing nut were removed and the head was held against the cylinder rod by means of a long bolt that passed through the gland, and a block across the other end of the cylinder. The end of the cylinder with the head thus held against it was then placed cornerwise in a good fire. When the joint had reached a good heat, common bicycle spelter and Fluxene, a brazing preparation for bicycle use on the market at that time,



BRAZING CAST IRON

was introduced. As fast as the castings reached a brass-melting point they were turned a little until the brass had flowed entirely around the joint.

The cylinder wall where it comes in contact with the head is but ¼ inch thick, yet the joint stands all the strain of the usual pump-handle kind.

This is my first and only attempt at brazing cast iron. Perhaps it was only "bullheaded luck," but it stuck. Will some of the readers of the American Machinist kindly give some pointers on brazing cast iron, the proper fire, flux, etc.?

An Automatic Wrapping and Packing Machine

Wraps Cakes of Laundry Soap in Double Sheets of Paper and Packs Them in Boxes for Shipment. A Machine for Stamping Toilet Soap

EDITORIAL CORRESPONDENCE

Almost everybody uses soap. But it is not everyone who knows that the cakes of soap just after finishing are brought to a machine which wraps them in two sheets of paper with neatly folded ends, places these cakes in rows, slides the rows into a box, piles one row upon another until the box is full, and then drops the complete box down upon a conveyer to be carried off to a table to have the cover nailed on.

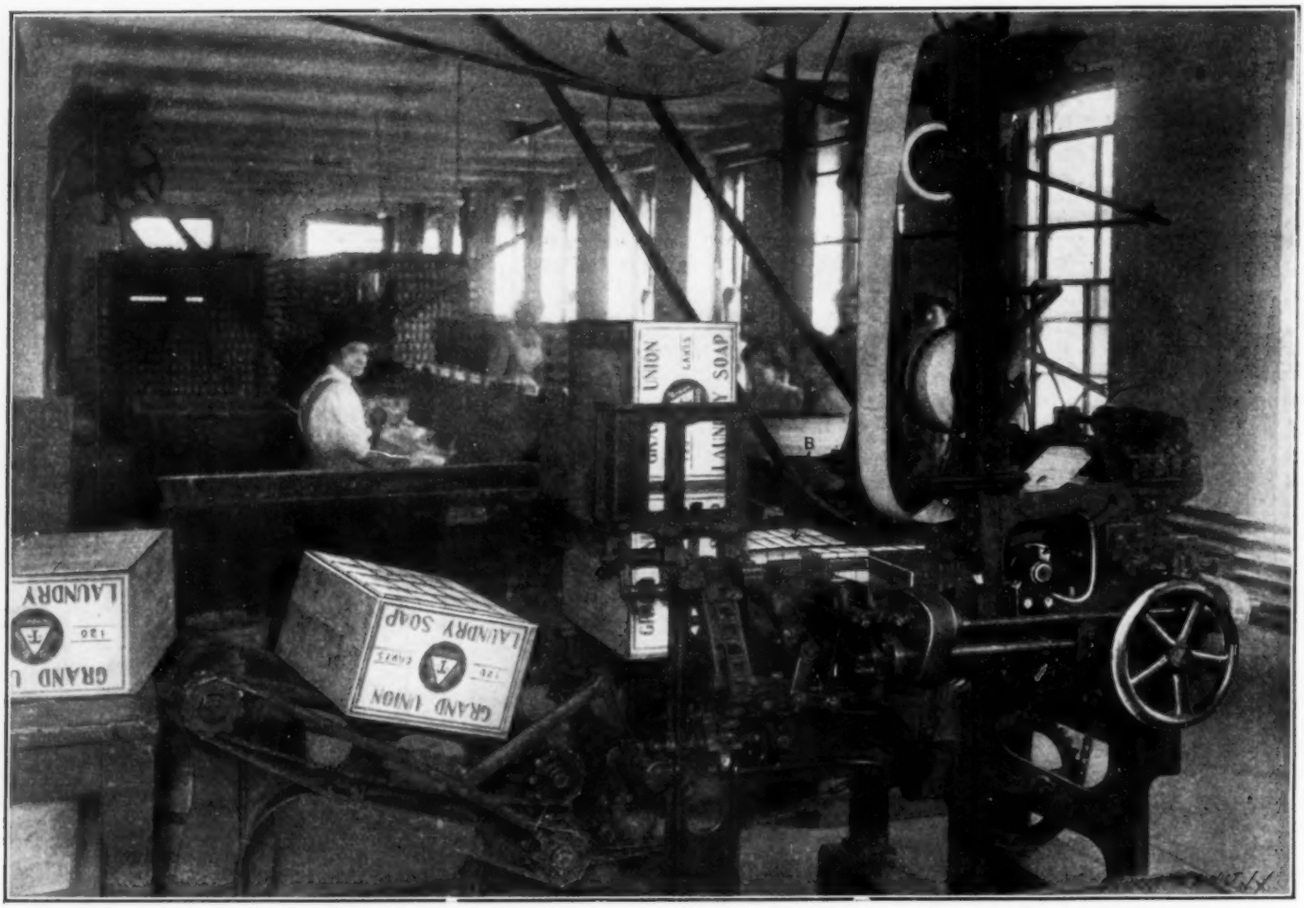


FIG. 1. MACHINE WHICH WRAPS CAKES OF LAUNDRY SOAP AND PACKS THEM IN BOXES
A, end of partly wrapped package in pocket. *B*, completed packages before entering boxes.

Such a combination wrapping and packing machine, shown in the accompanying illustrations, is in use in the plant of the Grand Union Tea Company, in Brooklyn, N. Y. Cakes of laundry soap are fed to the machine by a traveling belt, the cakes approaching on edge and end to end. As each cake is brought opposite the front of the machine a moving arm approaches and a sliding plate under the cake moves over so as to push the cake into one of four pockets in the periphery of a revolving wheel. These pockets are open at the ends.

In pushing the cake over into the pocket it is partially wrapped in the paper wrapper, which first hung vertically between the approaching cake of soap and the pocket in the revolving wheel. Pushing the soap against the paper and into the pocket causes the paper to fold over, covering the cake on three sides. After being securely held in the pocket of the revolving wheel, an arm drops down from above and pushes the loose end of the sheet of paper down over the front face of the cake, so that all four sides are now covered with paper.

As said, the wrapping paper is provided in two sheets, the inner sheet being of oiled paper and the outer sheet being the ordinary printed wrapper familiar to laundry soap. These sheets are fed to the machine in continuous strips, coming from two rolls overhead. As the printed wrappers are so designed as to make it necessary that each cake of soap shall be placed in a particular position in the wrapper relative to the printing on the outside, it is necessary that the paper of the outside wrapper should be fed to the machine in exact synchronism with the feeding in of the cakes.

Spacing the Wrappers

To secure this result the continuous roll of printed wrappers is punched with a round hole about ¼ inch in size at a certain position relative to the printing on each wrapper. As these wrappers are fed in between two rollers, there is a pin on one roller which projects into the hole through the paper. Paper being very easily torn, it will be realized that the simple hole and the pin on the roller would not be sufficient to secure the feeding in of the wrappers at the correct speed. To prevent tearing, one of the rollers is pro-

vided with a flattened section at one part of its periphery, along its full length. This flat place gives an instant of time when the strip of paper is not tightly held by the pressure of the two rollers against each other because when the flat place is opposite the paper and the other roller, the two rollers, of course, do not touch. Just at this moment when the paper is free, the pin on the other roller engages with the hole in the strip of approaching wrappers, the latter then being free to move slightly ahead or backward in order to give the proper registering without tearing the paper.

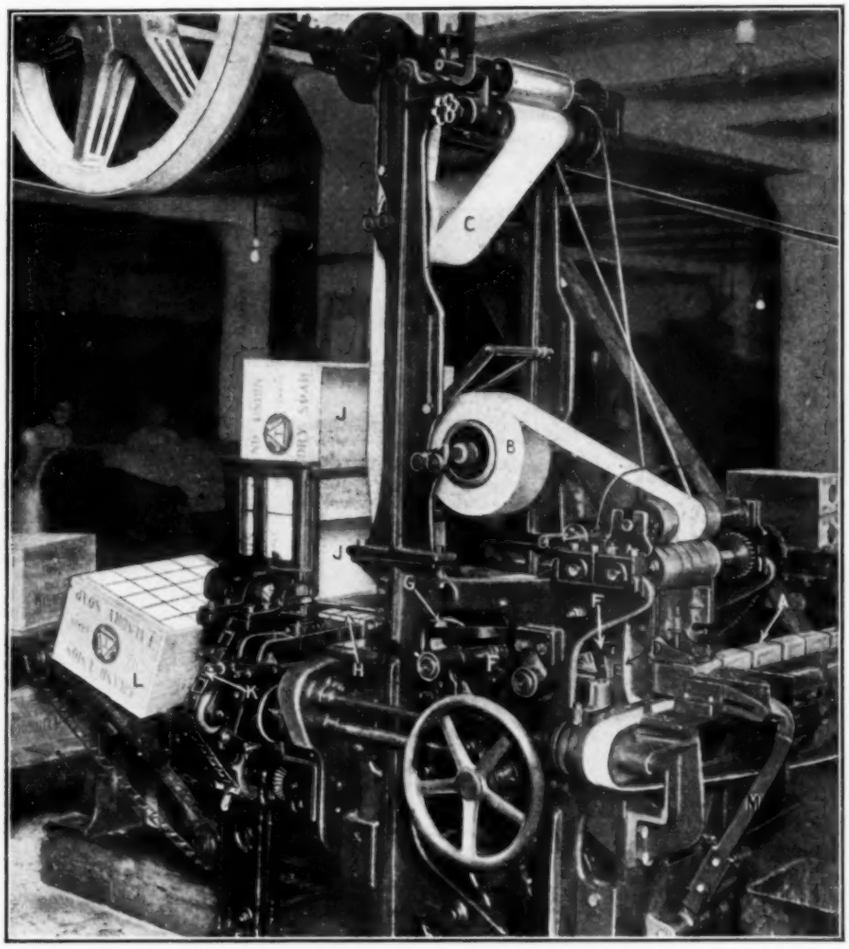


FIG. 2. DETAIL VIEW OF WRAPPING MACHINE

A, approaching cakes. *B*, oiled paper wrappers. *C*, printed outside wrappers. *D*, both wrappers in place to receive cake. *E*, first wrapping blade. *F*, pocket wheels. *G*, end of partly wrapped package. *H*, row of finished packages. *J*, boxes in line to be filled. *K*, chain which controls boxes. *L*, completed box on conveyer. *M*, feeding lever.

Cutting the Wrappers

At the time when sufficient paper has been fed to the machine to provide one wrapper, a knife, which is set longitudinally in one of the rollers, comes around and presses against the two sheets of paper, and the companion roller, in which is a strip of wood to take the pressure of the knife. The two sheets are cut off by this knife in exactly the proper length to form a wrapper of double thickness.

The wheel containing the pocket to receive the cake of soap, which is now surrounded by the paper wrapper on its four principal sides, though still unfolded at the ends, is caused to turn in progressive steps from one pocket to the other. This gives an intermittent motion, which allows an instant of time when the wheel is standing still with a pocket opposite the approaching soap cake, so that the latter can be securely placed in the pocket. With this construction it is seen that the pocket wheel having four pockets revolves in four equal steps of 90 deg. each. At the bottom of each pocket is a brass plate, which moves in a slide to approach and recede from the axis of the wheel so as to first receive the soap and its wrapper, and then when the wheel has made a turn of 180 degrees, to be pushed out again by a set of fingers at one end of the wheel so as to eject the cake with its surrounding covers. When ejected from the first wheel, the cake is forced by the brass plate into a similar pocket in another wheel which is like the first one, with the exception that the pockets in the second one are provided with finger plates at the ends of each pocket. These finger plates push the paper wrapper down on one side to cover the ends of the cake, just as is done with the hand to tuck in the first edges of the ends of the paper when wrapping a package. This second wheel also revolves in steps to correspond with the steps of the first wheel, so that the pockets in the two wheels come opposite each other.

Turning Down the Corners

After a revolution of 180 degrees of the second wheel the small package is brought against two stationary fingers outside of the wheel, which folds down one corner at each end of the yet remaining paper projecting from the package. This corresponds to the motion of the human hand in tucking in the corner of the paper of the package after folding down the end. At the same instant a pair of moving fingers approaches from above and pushes down the upper corners of the projecting paper, folding it in a smooth, neat manner, leaving only the familiar pointed end of paper, which is always left as the final piece to turn down in folding the end of a package.

At this point a set of outside fingers at one end of the second revolving wheel approach, and push the cake of soap out from the pocket by means of a brass plate at the bottom of the pocket, similar to that in the first wheel. Pushing the cake out of the wheel, it passes through an opening between two uprights, which are just a little wider apart than the length of the cake of soap, so as to fold down the last remaining point of projecting paper on each end of the package. This completes the wrapping, which is even more neatly done than could be done by hand, especially when the speed of wrapping is considered. The machine in question wraps just about 100 cakes of soap per minute. This is at the rate of 1⅔ cakes per second.

Making the Rows

Wrapping, however, is not the only work of this machine, for after the cakes have been securely wrapped and folded in the double thickness of paper, each wrapper, as said, being placed upon the cake in a particular position so as to bring the printing on the cover in exactly the right spot relative to the different faces of the cake, the neatly wrapped packages are slipped along a runway, on edge and following each other one cake behind the other. Six cakes placed next to each other with their flat sides together, just fill up the length of the runway. When the sixth cake has been pushed into the row, the first cake presses against a trigger, causing the rotation of a crank and connecting rod, to push the row of six cakes to one side, a distance just a little more than the length of one cake.

As rapidly as the row of six is pushed out of the way, more completely wrapped cakes continue to approach, filling up the runway, until when six more have been added, the trigger is again pressed, and

the second row of six is slid over against the first row, pushing the latter still further in a transverse direction. The second row of six cakes is followed by a third row of six, and finally by a fourth row. Four rows of six cakes of soap, making 24 cakes in all, constitute a group which is just the size of the side of the wooden packing box in which the cakes are shipped.

Packing into Boxes

Each group of 24 cakes, as it is completed is pushed against a trigger at the end of the slide upon which it is traveling, this trigger acting similarly to the first trigger, to cause an arm to push the whole group of 24 cakes in a lateral direction right into one of the wooden packing boxes, which is set up on edge at the side of the machine. Vertical traveling chains provided with fingers hold the packing boxes on edge in suitable guides, and after each group of 24 cakes has been pushed over into the box, the next motion of the mechanism moves the traveling chains to drop the box down a vertical distance equal to the width of a cake of soap, which is the thickness of the group of 24 cakes.

As each group is pushed into the box it is followed by other groups which, as the box drops down a step at a time, are pushed into it to form layers of 24 cakes one upon another. Five layers of 24, making 120 cakes in all, just fill the box and the next drop of the chains lets it down upon a cradle. This in turn gently sets the box with its contents upon a conveyer which carries it up to a table where attendants rapidly nail the covers on by hand.

An Automatic Stamp

Another interesting machine in connection with the manufacture of soap in this same establishment is one which has but recently taken the place of hand labor, and by its perfection is said to have had a markedly beneficial effect upon the soap industry. This machine deals more particularly with toilet soap, which owing to the oval and rounded shape of the cakes, and the necessarily neatly finished appearance of each cake, has heretofore required manual skill to produce. In the accompanying illustration there is shown a machine for stamping toilet soap with sufficient accuracy and neatness of work to supply the most exacting trade.

Toilet soap, after having passed through a number of processes of grinding up into chips and strips, being perfumed and rolled between granite rollers, is finally forced out in long solid bars about 1½ inches in diameter. These bars are brought to a table where they are pushed transversely across a large number of tightly drawn piano wires, which serve to cut the bars into cylindrical cakes about 3 inches long and, of course, the diameter of the bar. These cylinders of soap are fed by a belt-conveyer in a direction transverse to their axes and are finally brought to a pair of brass fingers, having rubber tips, which reach over the ends of the first soap cylinder and pick it up, just as would be done by the thumb and first finger of the human hand.

Transverse motion of the fingers carries the cylindrical cake to one side and holds it between a pair of dies, which move in a horizontal direction. The coming together of the dies squeezes the soap cylinder into the finished and familiar oval shape of toilet soap, and at the same time puts on the deep imprint of the name of the manufacturer, trademark, etc. Of course, the cylindrical cakes of soap contain very closely the correct amount of material to just fill the stamping dies, and only a small portion of waste is squeezed out of the opening provided for this purpose.

As the dies draw away from each other, a second set of fingers open out, drop down and grip the finished cake. A transverse motion of the fingers carries the finished cake to one side, where the fingers again drop down and open at the same time, placing the cake upon a moving belt conveyer, to be carried off to the wrapping counter and finally packed into boxes.

In the center of each of the dies there is a small plate the shape of which forms a part of the imprint stamped upon the material, and these plates are forced forward so as to push the cake of soap out from both dies at the time when the latter are separating. It is while the finished cake is being held by these spring plates that the second set of fingers grip it to carry it over and set it down upon the traveling conveyer.

S. B. R.

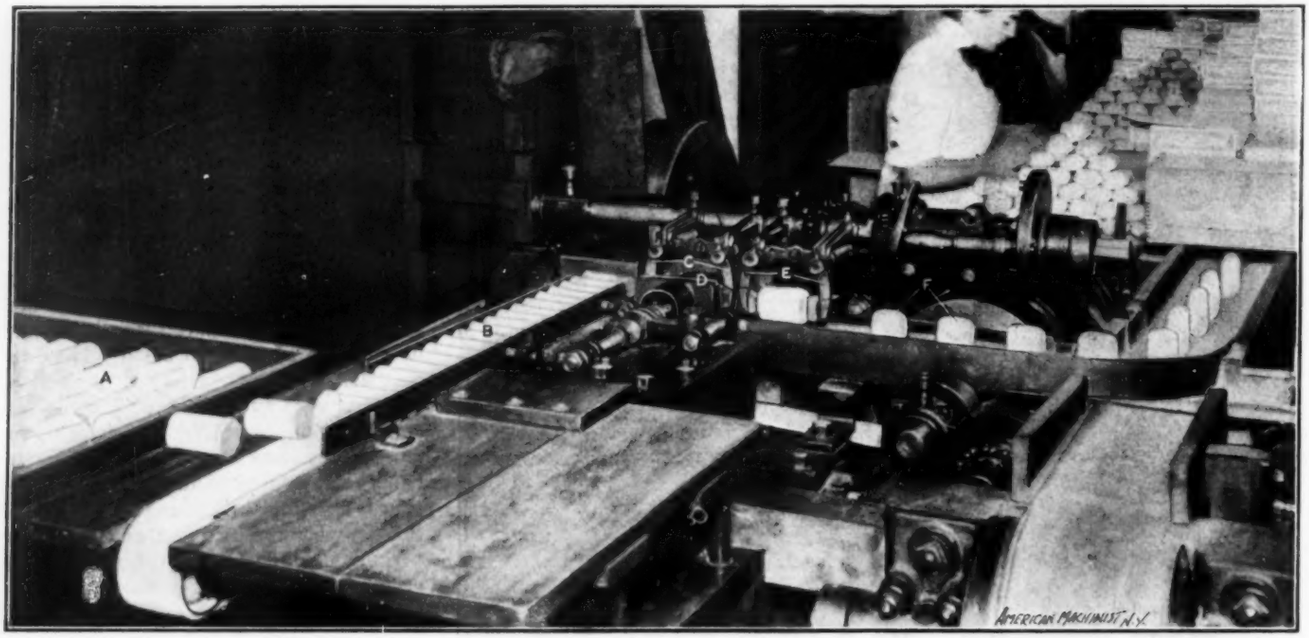


FIG. 3. MACHINE FOR FORMING CAKES OF TOILET SOAP

A, soap cylinders cut from bars. *B*, cylinders fed to dies by belt. *C*, fingers which feed dies. *D*, dies. *E*, fingers which remove finished cakes. *F*, finished cakes on belt conveyer.

In a paper presented before the American Foundrymen's Association, it was stated that the electric steel-making process has two advantages over the crucible process: first, it can use the cheapest form of steel scrap available in the market, and second, it can turn out the highest grade of steel made, the electric furnace surpassing all others in its control over the phosphorus, the sulphur, the temperature and the gases dissolved in the metal.

The Scherl Monorail-road of Germany*

A Successful Experimental Road Using Cars Held in an Upright Position by Two Gyrostats—Its Many Advantages and Possibilities

BY PROFESSOR WILHELM KÜBLER

A few months ago one of the best known German newspaper publishers, August Scherl, proprietor of the *Berliner Lokalanzeigers* and the well known journal *Die Woche*, brought out a memoir in which, after critical discussion of the present means of transportation, he presented, in a contrasting ideal picture, a railway of the future. This book, which was prepared by Richard Scherl, son of the publisher, has, through the boldness with which it brings together old and new ideas and the revolutionary project advanced, excited attention and comment both in expert and non-expert circles. Whether or not the possibility that the new rapid-transit system may be practicable is disputed in Germany, yet whatever may be thought of its adaptability for development and its economic features, which are pressing considerations in all railway undertakings, there has already been constructed from the plans of Herren Scherl a practical, operative, and operating mono-railroad.

*Translated by E. P. Buffett.

Scherl, in his railroad project, has assumed as a basis the present considerably increased speeds of travel. He has in view 200 kilometers (125 miles) per hour for a speed upon the main line and 120 kilometers (75 miles) per hour upon other lines. In the selection of these figures he draws attention to the results of experiments carried out, in the years 1901 to 1903, by the company established by the Allgemeine Elektrizitätsgesellschaft and Siemens & Halske, for high-speed electric railway research; which trials took place on the Marienfelde-Zossen track and in which a speed of 210 kilometers (130 miles) per hour was obtained. These experiments were animatedly discussed in professional circles, and in particular, their scientific principles were treated by Petersen and von Borries in the journal *Elektrische Bahnen*. They led to the conclusion that such high speeds, in continuous service, introduce a liability to three kinds of difficulties: First, they necessitate a considerably stronger construction and much more careful maintenance of the track, which must disproportionately increase the cost of operation. Secondly, they require a much greater radius of curves to prevent derailing, which renders the layout of the line on closely built or uneven ground difficult, almost to impossibility. This may be expressed as follows:

$$V = 4\sqrt{R}$$

where

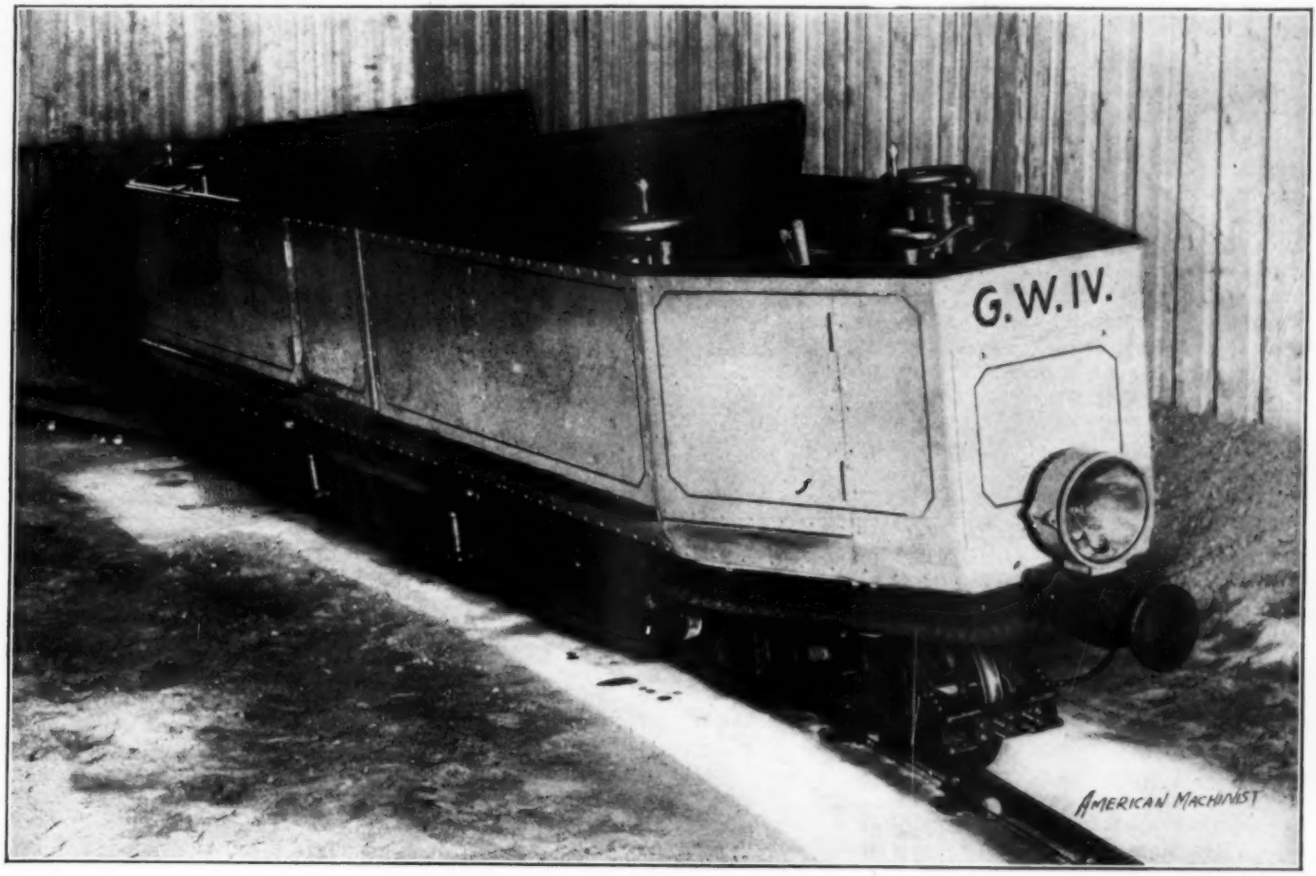


FIG. 1. SCHERL MONORAIL CAR

V = Speed in kilometers per hour, and

R = Radius of the curve in meters.

Thirdly, in case of any derailment fearful catastrophes must be expected.

With a proper regard for the importance of these considerations, the customary, and under old conditions reliable, two-rail road has been abandoned in the new system and the whole project based upon the employment of a single rail. It therefore became necessary to construct a car which, without fixed support, should

stably maintain an upright position at all speeds, whether in straight lines or curves, on level or inclined track, in quiet weather or stormy wind, or when curving incline slightly inward, and that all this should be effected whether the car were loaded symmetrically or unsymmetrically. Such a road was realized in the Langen suspended railway, of which there is an installation in Germany between the cities of Vohwinkel-Elberfeld and Barmen. Against this system, however, militated economy, and secondarily, also, certain practical considerations, especially the difficulty of constructing large railway yards. So attention was turned to an upright system and a solution of the stabilizing problem sought in the use of gyrostatic apparatus.

Possibilities in Use of Gyrostat

Everyone has more or less knowledge of the properties of the gyrostat acquired from children's toys, even if this knowledge generally be superficial. The researches of various investigators concerning the phenomena of the gyrostat, whose fundamental principle was laid down by Faucoult as early as 1852, have received comparatively little attention; the older technology having lacked not only the incentive, but also the constructive means, for practical application of its properties. But since then a more exact understanding of the conditions of stability for rapidly revolving disks, and progress in the production of extremely strong materials of construction have opened ways for its technical utilization. Men were formerly content with its application to astronomical and ballistic problems. At a very recent date the interest of engineers in gyrostatic action of all sorts was suddenly awakened by the project of Doctor Schlick, of Hamburg, to employ the gyrostat for preventing the rolling of a ship.

This took place, moreover, in an age of steam-turbine construction and of the Illgner flywheel accumulator, when there was no longer any difficulty or doubt as to the practical application of the gyrostat. Numerous projects for its employment have made their appearance, some of them for purposes of aviation.

Schlick considered, indeed, the important fact that the displacement of the axis of the gyrostat by any opposing force is primarily caused by the gyrostatic peculiarity of yielding to a force not in the direction thereof, but at right angles to it. He understood that, therefore, a steadying effect against the sidewise tipping of a vehicle is possible only if a certain mobility be given to the gyrostat in the direction of the longitudinal axis of the car. Furthermore, he showed that for complete attainment of his purpose he must seek to accomplish a certain damping of this motion by a brake contrivance. Finally, supported by the researches of Professors Föppl and Lorenz, he gave simple formulas for calculating the dimensions of the gyrostat. The basic formula is:

$$M = Jwu$$

wherein

M = The moment of the couple produced by deflecting the axis of the gyrostat,

J = The moment of inertia of the gyrostat,

w = The angular velocity of the gyrostat.

u = The angular velocity of the deflection of the axis of the gyrostat.

He carried out practical experiments which supported his calculations. It would be going too far here if I entered into all of Schlick's learned investigations. Persons interested will find them in the Year Book of the Schiffbautechnischen Gesellshaft, 1909, page 111, under the title "Der Schiffskreisel," by Otto Schlick.

Official Objections to be Overcome

Although this important work was already known, it did not suffice to place beyond question a practical execution of the "new system" for public railways. As might have been expected, the announcement of Scherl's project aroused the voices of doubters, including some very important authorities. In a country where officials maintain strict oversight of all public transportation facilities and in this oversight are generally very cautious, the question immediately arose whether the supervising officials would permit the use of a car maintained in equilibrium only by a gyrostat. What would happen if sometimes the gyrostat were to stop? Would the gyrostat be able, through centrifugal force and the gyrostatic effect of the flywheel, to withstand a lateral tipping moment of 250 metric tons, developed on curves at a speed of 120 kilometers (75 miles) per hour; to which moment must be added the wind pressure upon the concave side?

With a prudent and accurate foresight of such objections, Richard Scherl has not neglected to put the feasibility of the monorail system to conclusive tests upon a trial road. This course was the more proper because experiments had already, 1907, been projected in England by Brennan, toward the construction of a gyrostatic railway, but thus far nothing of the practical results had been heard. It was not to be foreseen that, by a chance, at the same time when Scherl publicly brought out his car in Berlin, Brennan on his part, would be making public trips with a monorail car equipped with a Heilmann type locomotive. It is in accordance with the peculiarity of German work, that in the solution of problems, little experimenting is at first done. Every experiment that is made serves solely for verification of knowledge that has already been reached by theoretical methods and so has been opened up.

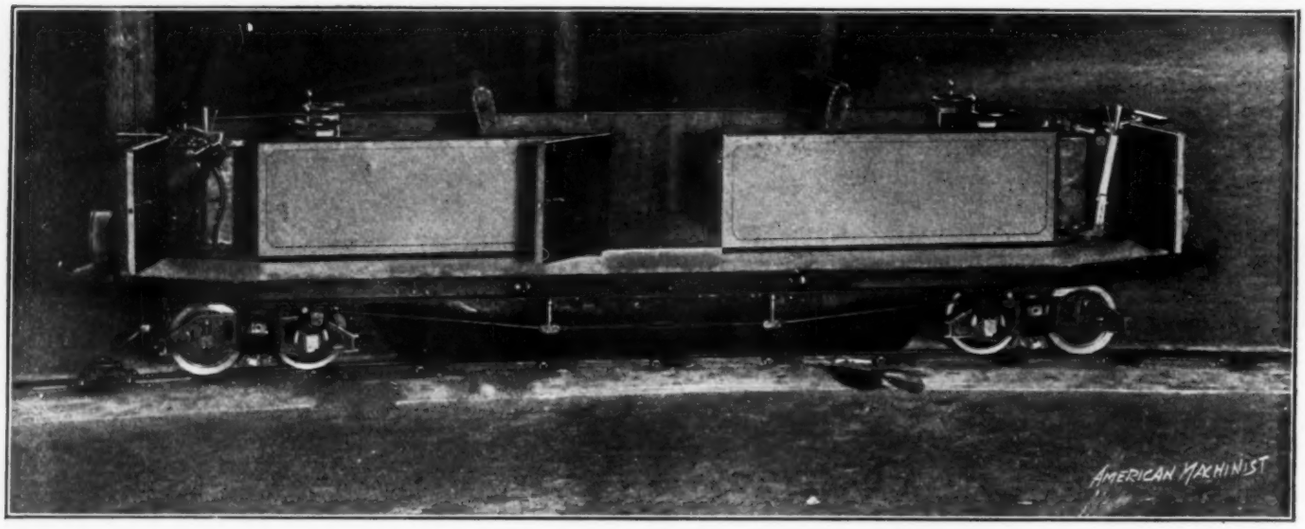


FIG. 3. ANOTHER VIEW OF SCHERL CAR, SHOWING CONTROLLING HANDLES AND LEVERS

Establishing of the Experimental Plant at Dresden

It was therefore possible at first to get

along with a small testing plant, restricted to what was urgently necessary for demonstrating the principle, and this was very quietly installed at Dresden. The work was begun there in the autumn of 1907. The direction of the testing plant was undertaken by Richard Scherl himself. The working out by theoretical mechanics, strength of materials and higher analysis, of those problems on which the task depended, which problems, as experts know, are not very simple ones, was undertaken by Herr Frölich and the constructive application by Herr Falke. Associated with the work of these gentlemen were three other engineers and twelve mechanics. The gyrostatic mechanism required a careful adaptation to the special design of the railway; moreover, it was necessary for the constructors to aim at great simplicity with a view to economy and to safety of operation. The trolley hindered attainment of the higher speeds.

The center of gravity of the vehicle naturally lies as low as possible in order to keep down the moment of the lateral vibrations. This is to be considered also in eventual electrical service, since it is known that the latest practice upon electrical railways inclines toward placing the motor in the upper part of the car, thereby raising the center of gravity of the car. The gyrostat in the Scherl car stands vertically; naturally this is not absolutely necessary, for horizontally running gyrostats could be employed as Brennan has done, at least in his first models. However, the vertical arrangement is probably preferable. If it be selected, the necessary mobility along the longitudinal axis of the car is comparatively simple to attain in construction of the cars; and that in this case the construction of the bearings and framework causes no disproportionate trouble has been shown not only by the Scherl car, but already by a very considerable number of Schlick marine gyrostats which have been made.

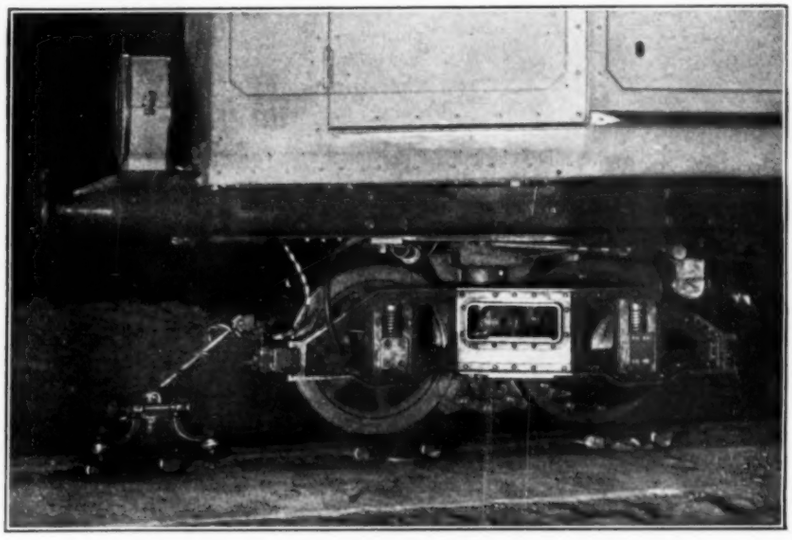


FIG. 4. TROLLEY AND CONDUCTOR OF SCHERL MONORAIL CAR

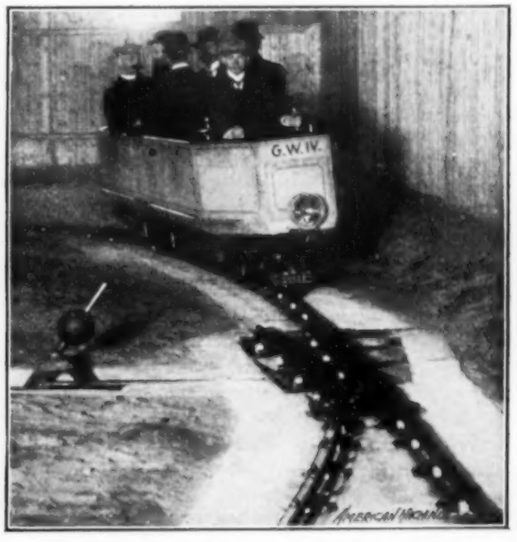


FIG. 2. SCHERL MONORAIL CAR IN MOTION

details thereof, in accordance with the gentlemen's desire, are withheld from publication.

Provisionally, however, there is shown as a result of the labors thus far performed the car in Figs. 1 and 2, of about 5.5 meters (18 feet) length and 2.5 tons weight, which is mounted upon two trucks, and which has traversed the most varied curves, including those of S shape and those of 7.5 meters (24½ feet) radius, with a speed of 12 kilometers (7½ miles) in safety and holding steadily to the proper position, inclined slightly inward. The wheels are driven by electric motors for whose operating current a conductor is provided in the track. It rests on rollers fastened to the substructure. Figs. 3 and 4 illustrate clearly the conductor and trolley. It is self-evident that in a perfected railway this rather primitive method of supplying the current would be superseded; neither the insulation nor the trolley would be satisfactory in practice. Even on the trial railway the primitive

The Trial Car

In the trial car the flywheels run at a speed of 7000 to 8000 revolutions per minute and upward, being driven by electric motors which are the only drive seriously considered for railway-car purposes. How high this rotary speed may go is still in question. Schlick holds 250 meters (820 feet) per second circumferential velocity as not excessive. De Laval, with his turbine years ago, exceeded 200 meters (656 feet). A speed of 200 meters (656 feet) has also been pronounced too high for the gyrostat. With such weight as is entirely admissible very effective apparatus may be attained. The weight of the gyrostat mechanism, in the car before us, requires some 6 or 7 per cent. of the total weight of the vehicle. It is self-evident that in selecting a speed regard must be paid to the construction of the drive and to the strength of the material, one of the best of which is nickel steel.

The revolving masses are inclosed in tight envelopes from which the air is excluded, so far as possible, thus minimizing friction, and using the least possible power from the motor. In the test car only about one-third of the horsepower was consumed by the gyrostat. As a result of the very small friction, it takes a great while for a gyrostat to come to rest, specifically about four hours. This removes the ground for apprehension that some disaster may befall the vehicle if the current be cut off from the gyrostat. In such a case the passengers have more than a whole hour in which to get out or in which to prop up the car by means provided for the purpose. Since, however, interruptions of current, if they occur, last as a rule, only a few minutes, they are practically negligible so far as regards the operating safety of the system.

In proportioning the gyrostat, attention must be paid, not only to the question of strength, but also to the construction of the driving motor. In the trial car there were no difficulties in this connection, other than such as might be called diseases of childhood, but in larger constructions, where higher powers for the driving motor must be considered, there will be need of greater foresight in designing. If the gyrostat is to run *in vacuo* it will be unavoidable to place the motor in the vacuum with it. The difficulty of cooling will necessitate a good deal of study. Very novel and interesting problems are, therefore, presented to the builder of the electric motors. The gyrostat motors must in every case be so calculated that they will be able to impart a sufficiently great initial acceleration; since, if the revolving masses require four

hours to come to rest, they also need a certain time to acquire their speed; and this is an important question in practical service. The assembled construction may be very compact, so as to exceed the critical rotary speed by a wide margin of safety. The development of this feature in constructing monorail cars is still awaited, but in any case the rotary speed of the gyrostat must be considerably reduced. It is self-evident from what has already been said that the gyrostat is not simply left to itself, but in a certain degree "governed," although by a perfectly automatic method. It is in the contrivance for this purpose that the inventiveness of the Dresden gentlemen has been especially displayed.

It is hardly to be feared that the gyrostats will take up much more space that would otherwise be useful. They are built very low in the car, to whose frame they are directly attached. Even if the space over the gyrostats be not adapted to seating purposes, some other use can be found for it. Constructive projects for further solution of this and similar questions have been undertaken. The designs that are being made, suitable for cars in general, may perhaps be somewhat modified for very long vehicles, where it is necessary to regard the torsional strength of the car body. It is possible also that for very high speed special attention must be paid to the effect of spring, and this must be considered, along with the gyrostatic effect of the flywheel, in relation to a correct entrance upon curves and a proper inclination toward the convex side of the curve. But I doubt not a moment that ways will be found to meet the conditions successfully.

A Present Disadvantage Is Noise

A single disadvantage is still present, although this also may be very easily removed; it is the loud noise produced by the flywheel, and sometimes increased by resonance. If the bearing be modified and the inside mechanism somewhat altered, this disagreeable feature will disappear.

If, now, it be seriously questioned whether this new vehicle is actually destined to lead an important advance in railroading, an affirmative answer may be given. The advantages of the monorail system have often enough been stated and are beyond doubt. It is much safer, easier and cheaper to lay a single rail very firmly and accurately than a pair of rails. It is also simpler to maintain this single rail with the care required for ordinary service.

The Track Used

As a road structure there is used in the Dresden experimental road a common iron bar laid on concrete strips. In the public introduction of the car, at the exhibition hall of the Berlin zoological garden, a common railway rail is used. I have had opportunity to ride in this car myself and to determine that smoothness and safety of locomotion throughout are not less than upon a double-rail track. When standing still and moving slowly, one or more persons could jump up and down without shaking the car.

The passage over unfavorable curves is possible in the Scherl car. The danger of derailing is not greater than on other roads, perhaps even less. It is not the least advantage that, should the car leave the track, on a level road at least, the gyrostat would, as a rule, keep the car upright. Naturally I will not say that there are no questions left for engineers to answer in future mono-railroad building. Even in ordinary railroading new problems are from time to time presented. But these problems are no longer of a fundamental nature, nor will they be such henceforth upon mono-railroads.

Grinding in Gears

By F. C. Mason

In the issue of November 18 Mr. Godfrey stated that he had some misgivings in regard to grinding gears together by the use of abrasives and oil. The principle involved is an old question, and my 25 years of experience have never shown anything to prove that it has bad effects.

In small shops, they usually have nothing better for cutting gearing than a milling machine, and usually the index head, being used for all manner of jobs, is not in any of the best condition. A gear to run quietly must have the blank of the right size, the teeth spaced accurately, the cut smooth and exactly concentric with the shaft. This lack of the latter is the cause of most gear noise. Automobile gears are made to run at fair speeds and if properly cut there is no reason why they should make any noise providing they were not heat treated, and even then if this was done properly, there should be no trouble. The trouble lies in the speed boss.

Gearing, to be accurate and to run quietly, cannot be cut at the limit of speed or quantities on one mandrel, as they usually are. I have made spur and bevel gears to run at speeds from 1000 up to 5000 and practically quiet, and the bevel gears cut on a milling machine at that.

After cutting on the miller, place the gears on the test plate and relieve the teeth by filing until they have the proper bearing and clearance for the entire length of face. This operation requires a person of some experience in this line of work. For readers who are not familiar with this method of making bevel gears would say that the test plate mentioned is a metal plate having two bearings. The bearings are first located on the plate and held by suitable clamps or other means to give the shafts the angle that the gears are to be run. One of these shafts usually has a crank for the convenience of the operator. This filing process will produce a very good running gear.

If you desire to reduce the noise to a minimum use the abrasive method. I have always used emery and lard oil without any evil effect noticeable, even on brass gears. Use a moderately coarse emery at first, say, about No. 80 and then 120. Run the gears in both directions, reversing at short intervals. Wash off frequently with gasolene or naphtha and test at speed to be run to determine when ground enough.

In sewing-machine work where the gears are small, they assemble gears and shafts in place and grind in with ground quartz. This grinding-in process is most peculiar from a mechanical standpoint. The gear teeth being made as near theoretically correct as possible, of course, would have very little slip on the tooth face. If there is no slip, why does the abrasive cut away the tooth?

Another illustration of the same principle is a professional glass cutter sharpening the wheel in the ordinary glass cutter. These wheels are about 3/16 inch in diameter and the same shape as a pipe-cutter wheel. The operator holds the glass cutter at an angle of about 45 degrees and rolls the cutter on an oil stone using a stroke of about 5 or 6 inches backward and forward. The cutter wheel of course rotates in this movement and still you can bring the cutter to a knife edge.

Use of Abrasives for Grinding and Lapping

In regard to using abrasives to grind in or lap bearings, have used emery exclusively on all metals except brass with no bad effects whatever. Have used it on brass, but not enough to say positively as to its good or bad after effects. On brass I usually use quartz or grindstone dust; as brass laps easily, quartz or the grindstone dust does the business as rapidly on brass as emery does on the other metals.

In regard to taking the finishing cut on a hardened gear by grinding, I believe it feasible and perfectly practical, and am sure a wheel can be produced that will hold its shape on a light cut. There should be an automatic device to keep the wheel to required shape.

From a report made by the official inquiry concerning the recent fatal accident to the airship "La Republique" it is noted the accident is attributed to a breakage in the screw propeller. Two distinct breakages in the steel tube of the propeller were found upon examination. From the report it is quoted that the first, or interior breakage, the cause of the fatal accident, is attributed to overheating, in consequence of a powerful rotation, attaining 1600 revolutions per minute.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

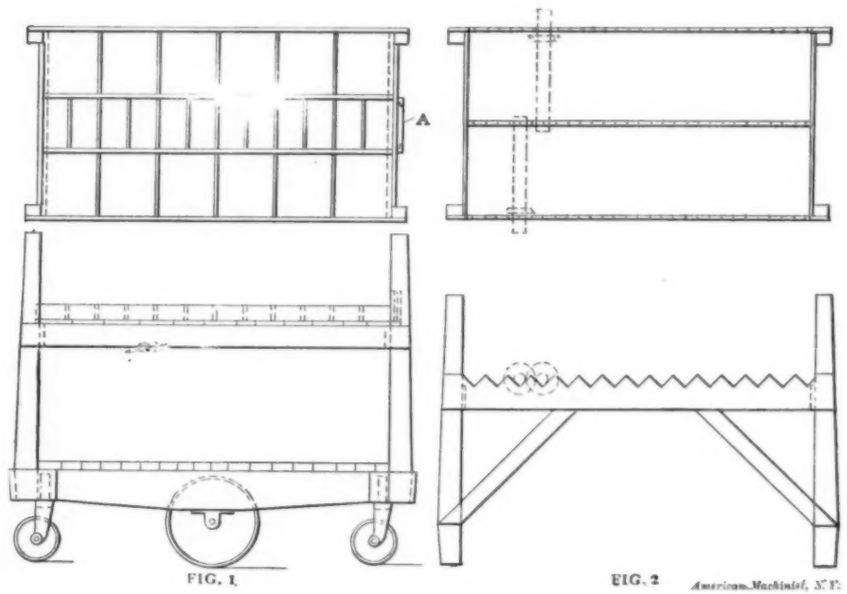
Shop Truck with Interchangeable Upper Decks

In a shop assembling 10 to 25 machines at a time we found that there was too much time wasted getting supplies from the stock room, making the assembly time higher than it should be. The men, too, not liking the delays, especially if working on a premium job, would get screws in large lots and leave them lying around, taking up room and drawing interest.

As a remedy we devised the truck shown in Fig. 1, or rather we added the upper deck to the standard trucks then in use in the shop. The upper decks were made so as to be interchangeable by lifting the four stakes from their sockets.

The deck was divided into suitable size pockets by means of a rack, made loose to facilitate cleaning. At one end, shown at *A*, a slide was made for holding a standard card giving the job number, number and name of the machines and any other information. The back of the card showed what parts were lacking when the truck was loaded and if any piece was borrowed to be used on some other job this was noted on the back; both being properly checked when filled or replaced.

The stockkeeper loads the truck according to a list, with all screws, bolts, pins, oil cups, wrenches, etc., and all standard parts made up in stock, noting any shortage on the back of the card, then taking steps to get the parts lacking. The truck, of course, does not take care of the larger castings, which are not so easily misplaced. The truck can be easily placed where it is most convenient to the work, making it much more valuable than a stationary stock rack.



SHOP TRUCK WITH INTERCHANGEABLE UPPER DECKS

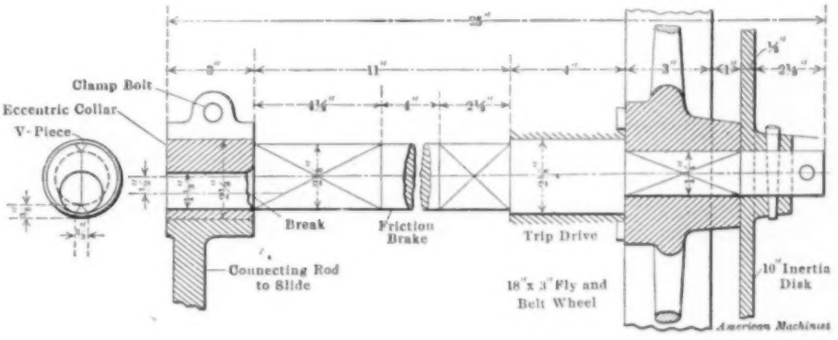
Fig. 2 shows another interchangeable upper deck made for holding arbors after being ground, saving them from getting bruised in handling. When at the grinder or on the assembly floor the rack is lifted from the base and set upon the floor convenient to the work, using the wheeled base only for trucking.

Grand Rapids, Mich. CLAUDE J. FRY.

A Built-up Punch Press Shaft Made about 1854

A broken driving shaft of an old, small, power punch press has recently attracted considerable interest among local mechanics.

There are two of these presses still in use which are reported to have been built by a local genius, in a small village repair shop of a new western State about the year 1854 or 1855. The presses have run with reasonable regularity ever since, with but few breaks. One of them recently was used to stamp out pieces with a circumference of about 5¾ inches from No. 10 sheet brass. The work naturally was too heavy for a small press of this sort and ultimately broke the crank end off the driving shaft, as shown in Fig. 1.



A BUILT-UP PUNCH PRESS SHAFT

A new shaft, with a smaller throw was made, and later the broken shaft was wanted for another repair job. When put in the lathe to turn, this shaft showed a peculiar seam which a careful investigation proved to be a joint running its entire length. A further investigation developed the fact that the shaft had been built up from four pieces of steel as shown in the end view of Fig. 1—two main halves and a small V-piece inserted in each edge of the joint. These four pieces had been so carefully fitted together that even after the piece had been finished in the lathe it was difficult to detect the joints, and it was still more difficult to drive out even a portion of the small V-piece with a hammer and chisel. No pins or other mechanical fastenings had been used to hold any of the four pieces together.

When the joint was opened up a small amount of a greenish-white metallic powder was found in it, but the quantity

was so small and knit so thoroughly with the steel that it was impossible to secure enough for analysis. The main portion of this shaft was used for a worm and worm shaft, and even the small V-piece in the threads of the worm, after some months of use, show no tendency to loosen or come out. Examination shows that the shaft in the second press is built up in this same manner, and it is still doing good work after 55 years of use.

The interesting question now arises as to how these pieces were put together, and especially so at that remote date, and in a new, half-settled State where it was probably necessary to haul all material overland by team from Cincinnati, or some center near there. What flux was used, and why were the V-pieces inserted? Who can tell? And who, in view of conditions under which this work must have been done, feels like bragging of our modern mechanical development and skill?

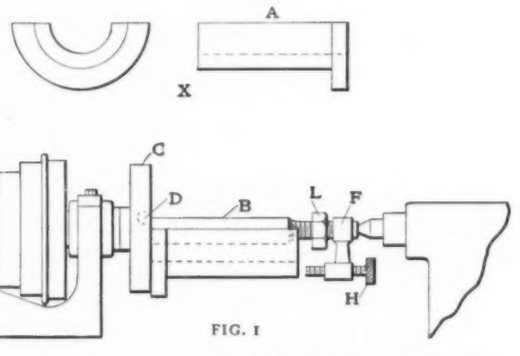
Tipton, Ind. A. TIPTONIAN.

Machining Half Bearings

The illustrations show a method of machining the bronze half bearings *X*. The faces *A* of these bearings are shaped in the usual way. Then the bearings with the face *A* are clamped down on the miller platen and milled on both ends to the required length. In Fig. 1 *B* is an arbor with a taper shank fitted to the lathe spindle. The faceplate *C* has two holes drilled and reamed, as shown at *D*.

Fig. 2 is a straight-edge used to locate the center of the faceplate *C*. When the pins *E E*, Fig. 2, are inserted in the holes *D* the lower part of the straight-edge is in the center of the faceplate. The half bearing is held in the left hand firmly against the faceplate *C* and the lower edge of the straight-edge. The graduations on Fig. 2 show the finished bore, the cored hole of the bearing being set accordingly. The fixture *F* is pinned on and revolves with *B*. The screw *H* in this fixture is tightened against the half bearing and holds it in place while the other half bearing is placed on top. The slip collar *K* is then placed on the arbor and the nut *L* clamps both securely against the faceplate. *H* is released and the bearings are now ready for turning. The bearings are lettered or marked in pairs as they are turned. The boring operation is done in the boring mill with the bearings held in a split chuck.

Detroit, Mich. C. S.



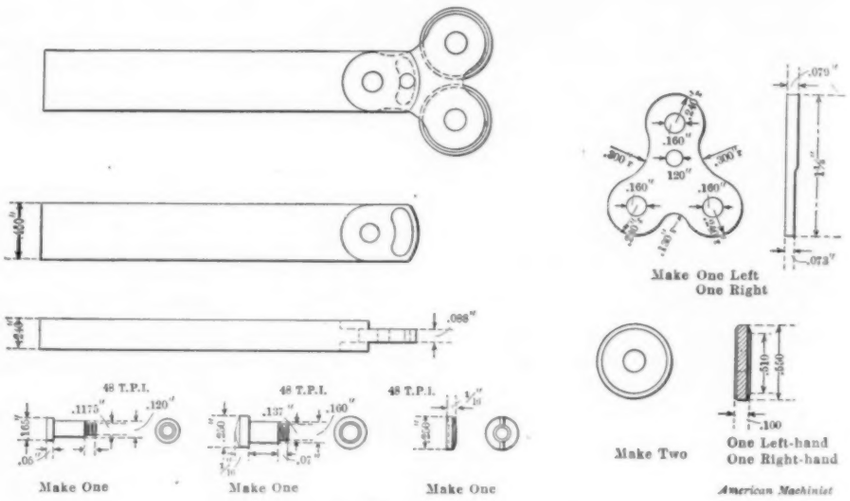
MACHINING HALF BEARINGS

A Nurling Tool for the Bench Lathe

In fine-tool and instrument work and especially on repair work the need is often felt for a nurling tool which can be used in the regular bench lathe. The one shown was designed for this purpose.

All parts were made from Jessop's tool steel although any good steel will serve as well, all bearings are ground to fit the holes after lapping them out to size and the surfaces on all parts are ground to make a neat job. A variety of nurls can be made to suit the fancy of the toolmaker or the requirements of the job and it will be surprising the number of times the tool will be borrowed. In the one shown, all parts were made on a Pratt & Whitney bench lathe.

Greenfield, Mass. B. L.



A NURLING TOOL FOR THE BENCH LATHE

An Improved Parallel Clamp

The cut shows the tool which daily proves its superiority over one of the usual design I carry, but seldom use.

The improvement consists in the two V's milled in each jaw. It is done quickly and accurately by gripping them side by side in the vise, lining up the screw holes and cutting the cross V's; then holding them point to point and cutting the longitudinal V's from one cross V to the other.

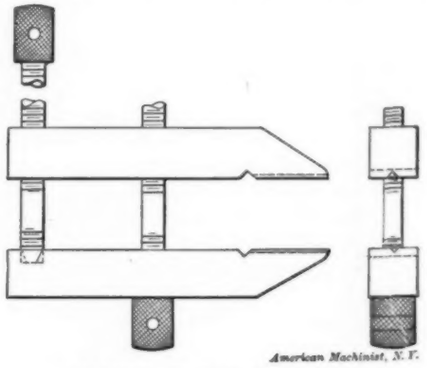
The cross V should be largest as it is designed to be used on heavier work owing to the longer leverage in this direction and to the point of grip (the centers of V's) being closer to the binding screw. It should be cut so that the distance from the near side of the V to the slope of the nose is about the thickness of stock used for the clamp.

Care should be taken to get the right proportion of this V so as not to materially weaken the clamp while getting a V large enough to be useful; 0.100 deep in 5/8-inch stock has stood up well under constant use for three years.

The corners of all the V's should be rounded off to protect them from the general wear of the tool.

Jos. H. BENTLEY.

Middletown, Conn.



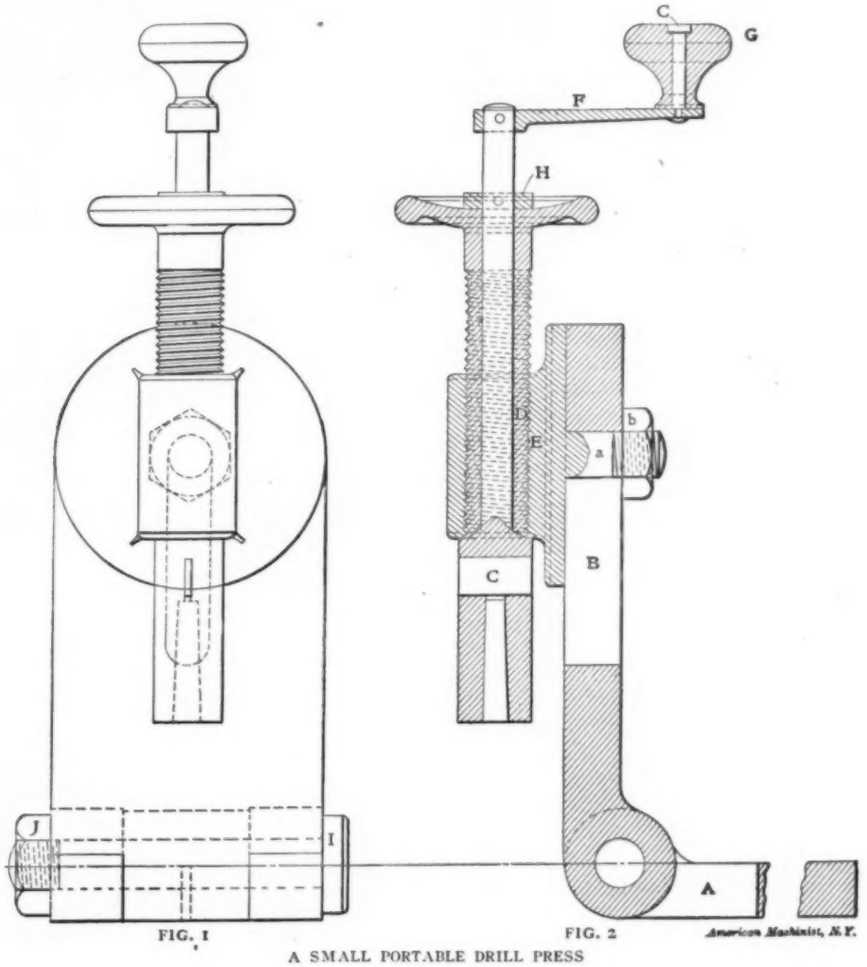
AN IMPROVED PARALLEL CLAMP

A Small Portable Drill Press

In the installation of machinery it is often advisable to drill and tap a number of holes after the work is well under way; this necessitates the use of the ratchet, or if the hole is not too large it is often done with the breast drill, and sometimes these holes occur in such a position as to be difficult of access even with these tools. For just such work as this the little tool, shown in Figs. 1 and 2, is very useful.

Fig. 1 shows the device in front view, while Fig. 2 is a side elevation sectioned on the vertical axis. The parts *A* and *B*, jointed as shown in Fig. 2, will allow of them being set at any angle. They are secured by the bolt *I* and the nut *J*, Fig. 1. A drill is inserted in the spindle *C*. The sleeve *D* is threaded into *E* to provide a means of feeding the drill to the work. The part *E*, pivoting on *a*, can be swung through an entire circle, and located at any place on the elongated slot in *B*, and is secured by nut *b*, Fig. 2. In order to firmly clamp the parts together, *A* is split, as shown by dotted lines. The functions of the parts *F G c H*, together with the operation and use to which the device may be put, are obvious to the average mechanic.

Baltimore, Md. ROBERT O'NEAL.



A SMALL PORTABLE DRILL PRESS

Making a Hexagonal Spring Chuck

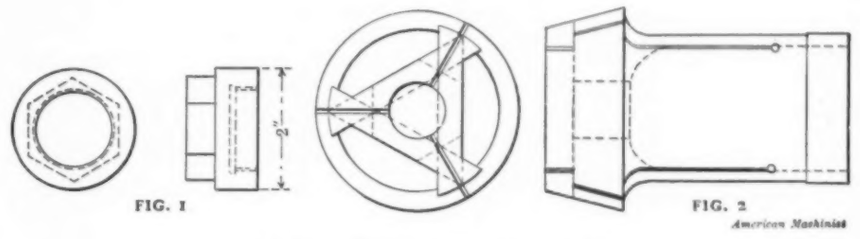
I had to make a spring chuck, Fig. 2, to hold the piece shown in Fig. 1, while being bored, tapped and faced in the hand screw machine, the piece being held by the hexagon which had already been milled to size.

Acting on the suggestion of the boss I did the job by the following method, which had been used before in that shop for such jobs:

In turning the blank, a recess the correct depth and the diameter, across the flats, of the hexagon was bored, a short arbor made to fit the clearance hole at the back of the blank, and the blank mounted on the index head with the head set vertically.

A cutter was selected of a width a little wider than half the length of the hexagon flat. The side of the cutter was then set so as to coincide with the extreme diameter of the recess, and three cuts taken through to the bottom of the recess, indexing one-third turn for each. Then, as the dotted lines representing the width of the cuts will indicate, we have remaining three sides of a perfect hexagon of the required size. In use the piece is efficiently centered and driven by three sides. The chuck has three splits arranged, as shown.

Manchester, Eng. GEORGE E. GAY.

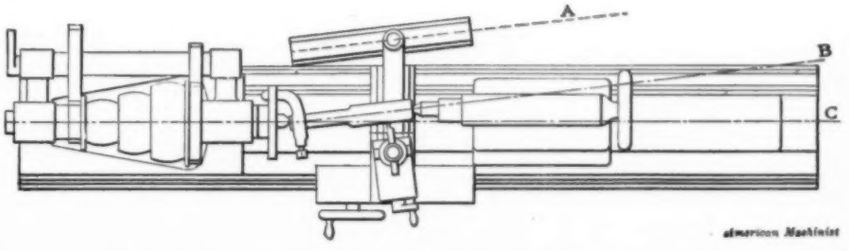


MAKING A HEXAGONAL SPRING CHUCK

Cutting Taps to Allow for Shrinkage in Hardening

Every toolmaker at some time or other has been up against the problem of making taps, particularly master taps, which must be extremely accurate as to pitch after hardening. The kink shown herewith is useful in overcoming the difficulty.

Cut a test piece in the regular way, the same size and shape as the tap to be made, harden and measure to determine variation in shrinkage. To correct this the thread on the tap must be cut longer in



CUTTING TAPS AND ALLOWING FOR SHRINKAGE IN HARDENING

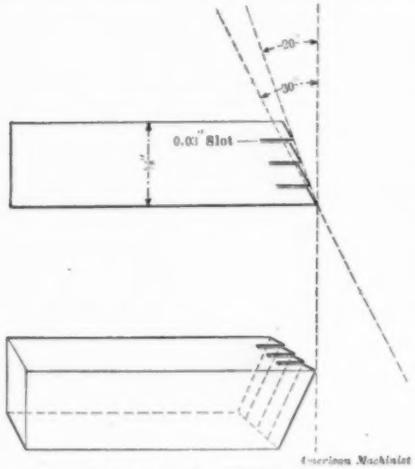
pitch. To do this without changing the feed gears is a very simple matter when understood.

The sketch shows the method, which I do not think will need much description. The principle is that of the triangle. The base would be the center line of the lathe, marked *C*, which would produce the normal pitch; the drawing shows the piece set off center and the pitch will be the hypotenuse, which can be varied to suit the requirements, according to how much the tailstock is set off center. The taper attachment must be set so that its center line *A* is parallel with the work center line *B*, otherwise the piece will be cut taper. The same method may be found very useful in making half-thread taps if the pitch is not too coarse.

Grand Rapids, Mich. F. C. MASON.

A Tool for Making Chips Instead of Work

This tool is designed for making chips, of a uniform size, which are to be analyzed by the chemist. It is made of 5/8-inch



A TOOL FOR MAKING CHIPS INSTEAD OF WORK

square high-speed steel. To resharpen the top of the tool only is ground. The angle to which the tool is filed regulates the depth of the cut, which may be anything between 10 and 45 degrees. Of course, the greater the angle the deeper the cut, and if too much metal is being taken off it heats and the chips may oxidize, which is not permitted.

The accompanying sketch shows a tool with four cutting edges, but we make them with as high as eight.

The points of the tool are on an angle of 10° degrees less than the parallel cutting edges. If these edges are not filed to a greater angle than the angle of the points, the slots will become jammed with metal and there will not be a clean separation of the chips. In hardening care must be used not to get the tool too hot or the metal is liable to run and fill up the slots.

Washington, D. C. CARL HYDEN.

A Center Punch and a Burring Tool

Fig. 1 shows a precision punch used in laying out precision center work for close drilling. The base is milled away, as shown, and rests on three feet; this ad-

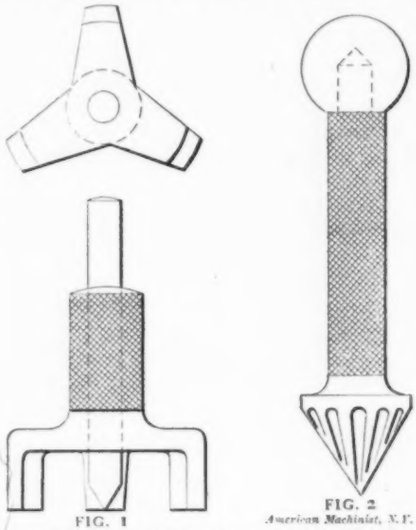


FIG. 1 FIG. 2
American Machinist, N.Y.

A CENTER PUNCH AND A BURRING TOOL

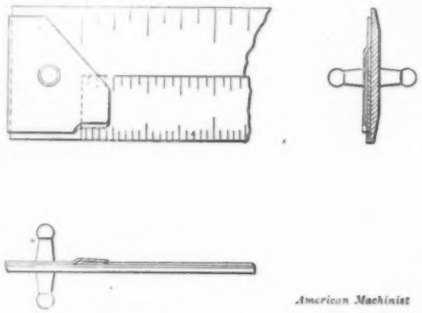
mits of more light, and better results are obtained than with the old style having a peep hole and slot.

Fig. 2 shows a hand 60-degree countersink, which is very useful for burring or breaking the corners of holes drilled or reamed in sheet-metal work. The tool is made in two parts; the 5/8-inch ball is driven on the body of the countersink and makes a nice rest in the palm of the hand when in use.

Detroit, Mich. CY. PRESS.

Convertible Draftsman's Scale

My most used scales are a Starrett's steel draftsman's scale and a flexible scale.



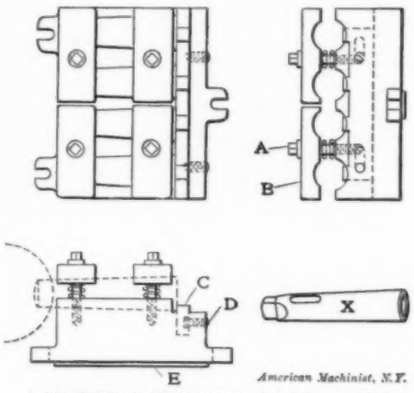
CONVERTABLE DRAFTSMAN SCALE

The draftsman's scale is divided into 8ths, 16ths, 32ds and 64ths, and the flexible into 100ths. Having had a call to layout drawings almost entirely in hundredths I found the flexible unhandy. I did not wish to procure other suitable scales so I made a pair of spring clips to attach to my draftsman's scale as shown in the sketch. They are made of about 15 thousandths spring steel and tempered to procure a good stiff tension. I unscrewed the posts of the draftsman's scale, passed the screw through a hole in the clip and re-assembled. Having the stock almost as wide as the scale and turned down over the end prevents any movement or loosening of the posts. The flexible scale is very easily slid in from the rear and pushed to the edge. This arrangement makes it easy for me to use the flexible scale in laying out drawings and gives me a variety of graduations which I would not otherwise have on one scale. EDW. J. LAWRENCE.

Harrisburg, Penn.

A Fixture for Milling Taper Socket Tangs

A gang of five round-cornered side milling machine cutters is used. The fixture is clamped and held in position on the miller table by three bolts, the tongue *E* fitting the slot in the table. The sockets *X* are held in position by the



A FIXTURE FOR MILLING TAPER SOCKET TANGS

screws *A* and clamps *B* and abut against the stop *C*.

On releasing the screws *A* the coil springs on them, hold the clamp up clear of the sockets. Stop *C* is moved forward equal to the length of the elongated slot which allows it to clear the sockets. It is held in position but free to slide on the screws *D*, as shown.

Detroit, Mich. S. R. C.

A consular report from Austria covering changes in motive-power machinery during 1908 in shops and factories of that country states that the greatest advance made during the year was in the use of electricity as a motive power. In many districts water power has been widely utilized through the construction of electrical plants, furnishing many thousands of added horsepower, especially for numerous small enterprises formerly using other means of electricity for motive power.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Notes on Shop Heating

Mr. Miller's notes on shop-heating plants at page 899 interested me greatly because after giving very careful consideration to all the systems of heating for the new shop, we have just started in this very morning to put in the only system that he passes by with little, or worse than little comment; that is, the vacuum system.

After talking about each of these systems with the engineers of the other systems, the following facts seem to remain undisputed: The fan-heater system costs least money to install and under some conditions least to run; the hot-water system costs the most to install and the least to run; the comfort of the shop depends less on the system installed than on the layout of the job. The more comfortable the shop the more it costs for original equipment.

In this particular building the first costs as quoted us were; for fan-heater system $2000, for vacuum steam $3500, for hot water $9000. This last was a bona-fide figure, but I have always doubted the sanity of the man behind it. Now, why did we pay nearly double for a heating system than we had to, and why didn't we pay more and get a better one?

Fan-heater System

In answer to the first question, let me say that there was a strong temptation to take advantage of the fan-heater system, and its low first cost. It takes up, however, a large space in the engine room which in our case we could ill afford to lose. The ducts must either be built into or onto the building, or else carried in sheet-iron boxes overhead in the first story. If they are carried overhead they obstruct light and make a too convenient storage place for dust. If inside the walls, the usual mill construction does not allow enough wall space between windows to get the air ducts up past the beams without obstructing light. The wall ducts add very considerably to the cost of the system, more than the fan men admit until you get your local contractor to figure on it. To cut that cost down they blow air in from only one side of the shop and then place the ducts as far apart as they dare; in some cases 60 or 70 feet apart. The wider the shop the farther apart they can place them; usually as far apart as the shop is wide, a little less if they feel at all anxious about the results. For this reason this system is peculiarly adapted to shops 60 or 80 feet wide. It is difficult to blow much further.

Narrow shops, like ours, only 40 feet, have to have so many ducts that it is expensive. Ours if made of brick as they ought to be would have cost us about $1000, bringing up the cost close to what we actually paid. Another thing that affected our case was that a portion of the plant is cut up in small rooms which require to be heated. Large open floors where the air can flow naturally back to the fan room, make the return circulation easy, but small rooms demand an opening for the easy exit of air which in our case was both expensive and undesirable. Of course, this system of heating, as any other, cannot be economically maintained unless the same air is heated over and over. To heat fresh cold air from 0 degree to 60 degrees is an expensive undertaking.

Hot-water System

The hot-water system is necessarily expensive because of the considerable size of mains and returns and radiation. The mains and returns must all be of one size in the aggregate because water is incompressible. The radiation must be ample because the temperature of the water must be kept under 212 degrees. The hot-water men and the steam men seem to have two entirely different ideas as to making a radiator effective; one, the hot-water man, allows only a drop of 20 degrees to 30 degrees in passing through the whole circulation. The steam man tries to get all the drop he can but only succeeds in doing about the same thing, but he tries to get out more heat on the same drop because if he can get the steam to condense in the radiator he has the latent heat of the steam to use, which is a big item. Whether he gets it or not depends more on the man in charge than on the system.

Vacuum System

The vacuum system may depend on expensive automatic "check valves" as Mr. Miller calls them, but on more than one installation that I know of these thermostatic valves, for that is what they are, have had the thermostats pulled out and are run only as throttles on the return from the radiator. The ordinary radiator valve would be all right for this purpose if no one could monkey with the adjustment. The valves that we are using are practically the same thing without a handle on top and a shield over the stem.

The beauty of the vacuum system is that the water level of the boiler relative to the heating coils or radiators is not a serious matter. You can run more or less heat around your building by controlling the vacuum pump. The first cost on an installation of only medium size is low, the small size of the returns (carrying only water) is nearly enough to make up for the cost of connecting up the exhaust vacuum pump so that the first cost is only very little greater than the gravity-return system. It pulls the heat through for sure, even up grade when it ought to be down, and knocks all the rest of them into a cocked hat.

Springfield, Mass. Con Wise.

Multiple Housings for Large Planers

In the article under the above caption, on page 903, Mr. Towlson does not state what provisions were made for driving this planer. The depth of cut and feed must have been very light, or some provision made for extra driving power to overcome the extra load caused by adding the extra cutting tools. Machine-tool builders do not, as a rule, build machines so heavy and with surplus power enough to allow putting on extra parts enough to triple the rated capacity of the machine. Mr. Towlson says it is the custom to fit the standards and the gap pieces to the benches, then put them on the planer and finish the tops six at a time. Any man with planer experience knows what it is to plane a piece when it is on stilts. It is almost impossible to keep one piece from chattering with any kind of a cut and feed. I would like to see how six would behave when all were being planed at one time.

I have had considerable experience with planers and their work and I believe by shimming and clamping these tables solidly to the planer table and using the proper amount of feed the saving in time over the former method with its necessary light cut and fine feed would be very much increased.

The principle advanced by Mr. Towlson is, I think, very good, but it would require a specially built planer, very rigidly constructed and very powerful to do the work economically.

Poughkeepsie, N. Y. A. A. B.

Inventing and Patenting

It is a delight to read the communication of your correspondent E. C. S. on "Inventing and Patenting," on page 880, I should like to meet E. C. S. Such a lucid exposition of a subject in such few and well chosen words is a rarity. One hardly looks for literature in a technical magazine, yet I venture to say the article referred to is infinitely better than 90 per cent. of the efforts offered us in the literary magazines, to say nothing of its sound "uncommon" sense.

There has been, and probably will be, a fearsome amount of twaddle written about the inventor. I plead guilty to a few inventions myself, so I suppose I am privileged to speak.

The "ultimate consumer," Oh! happy phrase, doesn't care a continental whether a thing is patented or not, or whether a company has been formed or not, but the "inventor" often thinks the whole battle is won when the patent is issued and the company formed, although in fact the battle doesn't really begin until the consumer is tackled. The commercial conditions are what finally and absolutely test an invention. Shall an inventor be absolved for having no commercial brains? The merchant isn't.

A curious thing is the parallel development of ideas apparently not related, but which ultimately converge and unite. Witness how the underground trolley was born of the cable street railway.

Inventors have wasted much effort on a two-spool lockstitch sewing machine, which for obvious reasons is a delusion, because a rough wooden spool can never be successfully used in a shuttle owing to the unevenness of tension it produces, and for other reasons that practical sewing-machine men understand. At the same time the thread manufacturer is steadily getting away from the small revolving wooden spool for any manufacturing purpose. The paper tube with a very large quantity of thread wound on helically has replaced it entirely. With this the thread is taken off the top without any friction. At the same time from Switzerland has come the "cop" of thread without any bobbin, for embroidering-machine shuttles, which is also wound helically like the well known ball of twine, and from which the thread is drawn from the center, again without friction, and containing a much larger quantity of thread than can be put on a metal bobbin of any kind.

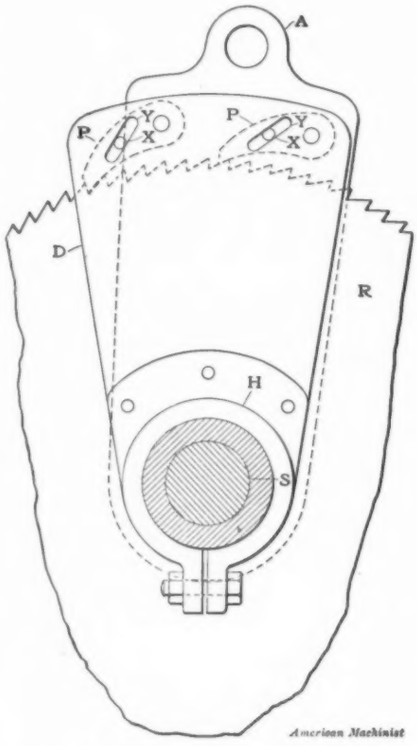
The next step I expect will be the standardization of such "cops" of thread by the thread makers in conjunction with the sewing-machine makers, and then, presto! All the efforts of the bi-spool inventors will be only a vain imagining, and all the troubles caused in high-speed lockstitch sewing machines owing to a revolving metal bobbin and uneven tension, will disappear, but some inventors will never know it, and will still invent shuttles with large revolving bobbins.

ROBERT J. HEARNE.

New York City.

Another Silent Pawl

In addition to the silent pawls shown on page 891, I should like to add one that has been used successfully for many years as a positive feeding device on an automatic machine operating at fairly high speed. The arm *A* carrying the pawls *P P* is made to oscillate about the shaft *S* by a variable throw crank used for changing the length of feed. The ratchet disk *R*, which is keyed to the shaft, carries on its hub a split hub *H* to which is riveted a piece of sheet steel *D*, in which are cut slots *Y Y* at an angle of about 45 degrees with a radial line; into the pawls are driven pins *X X*.



A SILENT PAWL

The device acts as follows: In feeding, the arm *A* moving in a counter-clockwise direction causes the pins *X X* in the pawls *P P* to ride down in the slot *Y Y*, thus forcing the pawls into engagement with the ratchet disks, thereby turning the device as a whole. Upon reversal the pins ride outward until they reach the end of the slots and then drag the sheet-steel piece, which has an adjusting screw in the split hub, back with them.

FREDERIC S. WILLIAMS.

Amsterdam, N. Y.

Notes and Comments on Industrial Training

Kindly allow me to encroach on your valuable space for the purpose of amplifying the remarks made by James Vose, on page 916. Mr. Vose is quite right in stating that in England apprentices can be had for the asking; in fact, the supply is so plentiful that the apprentice has unfortunately been used (or rather abused) by a good many employers as a means of obtaining cheap labor. Educational facilities are plentiful and the mechanic has plenty of opportunity to obtain knowledge, but the only advantage he gains is the knowledge, for his wages do not rise very noticeably. Technical graduates, after a three or four years' college course, have to work for $3 or $4 per week, and their salaries rise very slowly, unless they happen to possess a considerable amount of influence, which will cause them to be pushed along, whether they merit it or not. The style of advertisements quoted by Mr. Vose are of weekly occurrence in all the technical journals.

The majority of English engineers are not earning much more than $15 per week when 30 years of age. Manufacturers do not need to pay high wages because the labor market is overstocked. America could obtain a large supply of trained and skilled men from England if it wasn't for the labor contract law. But an average married man, or a man of small means doesn't fancy leaving his own country to travel 3000 miles on the chance of finding a job at the journey's end.

New York. S. M. H.

Worm and Spiral Gears

Referring to the article by John R. Godfrey on page 939 of the December 2 issue of the AMERICAN MACHINIST on worm gears, would say I do not know whether he refers to a multiple drill designed and built by me or not, but but we have had such a device in use for nine years on a large number of machines and our experience more than bears out the point he brings up. The main driving spiral which varies from 1 foot long in the small machines to 10 feet long in the largest, is 3½ inches outside diameter, 5 pitch, 11 teeth, 45-degree angle, cut from a solid bar of high-carbon steel, the feed worm on these same machines being ½-inch pitch, single thread, about 2 inches outside diameter.

In nine years we have no knowledge of one of the main spirals ever having given out, whereas in very hard service some of the worms and worm wheels have had to be replaced. This main spiral on the longer machines is supported its entire length in a groove planed in the rail, so there is absolutely no chance for the gears to spring apart.

From a rather extended experience with worm and spiral gearing, I have found spiral gears of 45 degrees angle or near there, give very satisfactory results, both as to efficiency and long life, but that ordinary worm gearing of a few degrees angle is very unsatisfactory if worked either under heavy load or at anything like high speed.

Moline, Ill. WILSON P. HUNT.

The Entropy System of Paying for Work

Many a time in the past I have directed a little dig in the direction of W. Osborne without raising a ripple. Now I see he has got after me for my new system of paying for work. Or rather his men have. Evidently he (or they) read between the lines in my article, and I expect that I can see something of an interlinear edition of his; but there is one impression that readers of his article, whose eyesight is not so keen, will get that is not correct. That is the impression that I do not believe that working people are honest.

A man may not do what I wish he would, and yet be perfectly honest. He and I might do exactly opposite things under a given set of circumstances and yet both be honest.

HONEST YET MISTAKEN

To illustrate, let me tell about one man who worked for me some 15 years. At one time I had him on the lead-screw job. He told me when I put him on it that he could not cut a good lead screw. That showed him honest at least, but he was mistaken, and I made him prove it. You can also judge that I thought he was honest because at the time my name was on the back of a note of his for a thousand or two without security. You will have to take my word for it that I still consider him perfectly honest.

Now that man did not know anything about the proper rate to cut lead screws. He was, I believe, perfectly independent of any other man in the shop in all his actions. He got so he cut a good lead screw, but he was no quicker about it than the others had been. I mentioned to him that I could use more lead screws, but he said he was doing his level best. I suggested speeding up the lathe, taking a little heavier chip and letting the engine do the work while he looked on. He told me the same old story that he knew that that kind of steel could not be cut any faster than he was doing it or it would tear up. I suggested giving the tool a trifle of clearance on the front side instead of letting it rub, and decreasing the clearance on the other side. He got mad.

Then I had the tool-room man get out a dinkey pair of cutters like a thread-milling cutter, cut the same lead but left-hand, and with only one tooth milled out. I explained to him that these were something special that I had designed with considerable scientific research and asked him to try them out while I was there. We worked over those things until we were getting out lead screws in less than half the old time, and he went on using them for six months and piling up work to beat the band.

One day I happened to notice that he had the old-style tools in and was working away with them. He explained that he had broken one of the circular cutters and had put in a tool to run until I got him a new one. The tool worked so well that he ground up another for the back tool. Said he liked the old-style tool better and thought that he could do better than with the circular cutter. We never made him any more cutters.

Now that chap was perfectly honest, but he was mistaken. I believe that nine men out of ten are mistaken, this includes Osborne and myself, in their judgment of the best way to do a job of any kind. By the way, this man I was telling about was raised in the Oil Country. He says Osborne's yarns are not a circumstance to some that he could tell if he stopped to think. Some he told me to were too fishy for me to repeat.

Well! now you see, I have no fault to find with the men with whom I have been thrown in contact on the score of honesty. What I do feel is that there is no educational influence that will beat dollars and cents in its quick and permanent effect.

THE FAIR DAY'S WORK IDEA

We have foundries here in town where a bench hand puts up 24 flasks in a day. We have other foundries where they put up anywhere from 50 to 75. The first ones are on day pay, the others on piece work under a set of men who have not cut rates for years and whose employees respect them. Now I have personal friends at the benches in both kinds of places, and no one wants to tell me that they are not honest; that is, unless he does it over the telephone. Those men that are putting up 24 flasks for $3 honestly believe that they are doing all that their $3 pays for. They are all willing to do more but not unless they are paid for it. To do more work would mean more exertion; it would mean giving up more of what they have to sell, and they do not see any more reason why they should do that than they do for raising their own bid at an auction.

I confess that I do not see how they can be criticized for their attitude. If it was my case I should do just what I have done in the past and not very long ago either. I would do all the work that I thought I could without injury to my health and then ask for pay in proportion to my work. If I did not get it I would get another job and get out. Of course, if your old employer has to pay your successor more money for the same work than you asked him, it doesn't help your pocket-book but it does your feelings. Your new employer may be willing to pay for what you do; if he is not willing; move on!

Many men are not so situated that they can pick up and move to better paying places; many have houses of their own on which they are making regular payments. They live in their houses and could not afford to go anywhere else to pay rent for the sake of a better job. These men are perfectly honest, in not doing more than custom demands. Their employers may be honest and they may not, but I suspect that out of a hundred employers and employees there are more employers who take unfair advantage than employees. Take any shop where a standard amount is understood to be a "fair day's work" and none of the men exceed it. Whose fault is it? Usually the proprietor's. He has demanded too much for his money, has not rewarded extra effort with extra pay, and has effectually squelched every attempt to raise the standard.

THE ENTROPY SYSTEM AGAIN

By the Entropy system, which has more good points than I thought when I suggested it, an employer could not set a price at all. He could regulate the price somewhat by giving good facilities and by offering such treatment as would keep a good number of active workers always under his roof to bid for jobs.

Take a case that came up yesterday. We want to put down a concrete floor in the boiler room. I called up two firms. One said, "We will put that in for $1.50 per square yard." The other said, "We need the work at this season, we will put it in at $1.35." An hour later the second firm rang us up and said that they would do it for $1.25, but they had always charged $1.55 and they wanted us to keep it dark. They explained that they had another job of inside work coming later; they wanted to keep their men together and our job would just fill their needs and they wanted to have it even if they lost a dollar or two.

Now the Entropy system simply applies this thing to men instead of firms, and to small one-man jobs rather than larger jobs where men have to work in gangs, like this floor.

Whether this thing can be applied to college professors or not, as Osborne suggests, I do not know, but I think it would be a mighty good thing to try. Just for amusement I asked one of them since reading Osborne's article if he was getting all the money he thought he ought to. "No," he said, "You know pretty well that we are paid pretty slim salaries." "Yes," I said, "but you do pretty slim work. Suppose they offered you 50 per cent. more money if you would do 100 per cent. more work?" "I would take it up in a second." They could too. The worst of it is these chaps all know what snaps they've got and they don't propose very often to give it up.

Of course, if Osborne came on here and talked with this same professor he would have heard a long tale of woe about underpay and overwork, but when a man who has just about a $3 a day head on his shoulders can go into a college and draw a dollar and a half an hour for his actual teaching time, you could get a pretty good line on the actual condition of things. They do just the same thing the man in the shop on day pay does. They find out what the usual salary is, and they find that it is low. They find out what the usual amount of labor is, and it is pretty low, but the two seem to just about match up. He honestly thinks that he earns all he gets and he honestly believes that if he earned more he would not get it, and I agree with him. The board of trustees that see him earn more than he gets, and refuse to pay for what he has done only have themselves to examine as to honesty.

No Such Thing as a Fair Day's Work

Barney tells us that "the boss that doesn't know what a day's work is, is the one who is the hardest to please." If he is right they must be a hard lot to please, for I do not happen to have run across one that did know, and I do not expect to unless it happens by accident. Fact is, there is no such thing as a "fair day's work."

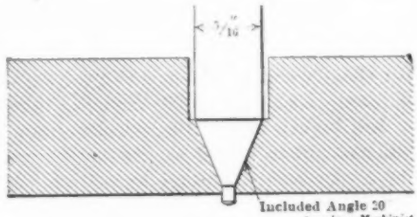
Barney and I might alternate day after day sweeping the same shop floor. Possibly Barney has a longer reach than I have; possibly I have a better digestion; possibly he has less to worry him at home; possibly the men like me and will stand out of my way and will not keep me waiting to do a little fancy sweeping around the drill press; possibly Barney doesn't like to stop and talk so well; possibly I am more particular to move that casting that has stood up against the third post from the office for the past 10 years. Just possibly, you know, I might average to sweep that floor in three hours and Barney might average four.

Now we will suppose that Barney's and my rich uncle dies and leaves us money enough to buy out the shop. We hire a man to sweep it. We know how long it took us and we both know that the boss was pretty good to us to let us take so long, so we make the new man hustle and do it in two hours. By and by he quits; says it is too hard work. We hire another; he takes 2½ hours, and we wink at it and say: "It's a shame to see how the boys are degenerating; when we were younger we could have swept this place out in an hour and never felt it." By and by we lose sight of the floor-sweeping record and it gets done in three or four hours, and everything moves along swimmingly. Curious world we live in, isn't it?

Springfield, Mass. Entropy.

Making an Accurate Pin

Referring to the article at page 838, under the above title, I would advocate as the remedy changing the design and making it like the sketch herewith. The pin,



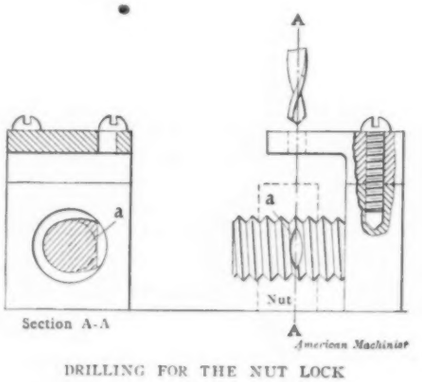
SUGGESTED FORM OF PIN

if made as shown in Mr. Jones' sketch can only drop out of its own weight when the fit is loose at the small end and all the bearing is near the top where the curve has angularity enough to release it; the bearing being above on the large part the point will not be held extremely rigid. It is not practical to make it in large quantities and expect the point to fit closer than 0.001 inch.

Baltimore, Md. Don Carlos Auton.

A Nut Lock

To the objections raised by Mr. Strauss on page 918, referring to the nut lock on page 670, I should like to state that it



DRILLING FOR THE NUT LOCK

was published as a useful idea and not as a commercial proposition.

While I would not say that a useful idea cannot be developed into a commercial proposition, I think, the space in the American Machinist devoted to practical letters is really a trouble saver for its readers, if one is up against a problem that cannot be solved by everyday standard methods. At least that is the use I get out of this particular column.

There are two principles made use of in nut locks; the positive stop and friction between the thread of nut and bolt.

The latter method was employed, when I made the special lock nut, which was not only intended to keep in place, but to tighten when there was any tendency to unscrew. The taper pin for a ½-inch nut was a ⅛-inch cotter ground to fit the thread and hole, and it did not appear as if there was any danger of "busting" the nut while locking it.

The fixture used for drilling the holes in square nuts is shown herewith. The part of the thread cut out at *a* is the complement of the hole drilled in the nut at this point.

Newark, N. J. Arthur Lowry.

Sawing Thin Brass or Copper Tubing

On page 875, P. J. A. tells about sawing thin brass tubing with a hack saw.

A few months ago I had 14,000 copper ferrules to cut from 8-foot lengths of thin tubing. I first tried the hack-saw method, which resulted in many broken blades and distortion of the tubing, caused by clamping them in the hack-saw vise. I then took a 5-inch fine toothed wood saw and put it on the emery grinder arbor, and clamped an iron block to the grinder rest to gage the ferrules for length and went ahead, sawing the copper ferrules about as fast as I could push the stock through.

Janesville, Wis. J. A. Raught.

[Electrotypers use an ordinary buzz saw for cutting electrotypes, copper halftones, etc., and in brass mills the same tool is used for slitting brass and copper strips for grilles.—Ed]

A Spring Winding Rig

I notice an article on page 837, on a device for winding initial tension closed coil springs, and I wish to take exception to the statement that the described device left nothing to be desired. It is quite obvious from a casual inspection of the scheme that the rollers will crush the wire, and this naturally would result in a spring of uneven tension, as the wire would lie with the longest portion of the oval section sometimes in one position and sometimes in another.

Having had occasion to devise a machine for winding springs of this character, I have found that the principal objection to feeding the wire into the curling mechanism with rollers was the inevitable flattening and irregular section which would result from the tension necessarily applied to the rollers, in order to grip the wire for feeding purposes. Of all the spring-coiling machines that have come to my attention there are none which will wind a closed coil spring of uniform initial tension, and while the problem on its surface seems very simple, its solution will be found extremely difficult.

Clarence Carson.

Dayton, Ohio.

A New Fusion Welding Torch, and How to Weld Different Metals

By W. I. Reich

In most of the chemical reactions we find that heat plays a very important part. Heat maintains life in animals and plants and will separate and unite metals. Oxygen and acetylene, employed judiciously, will produce a very useful temperature, that may be used for uniting metals by the autogenous or fusion-welding process.

The simplest welding installation is the one using both gases in compressed form, which makes the apparatus portable. Furthermore the gases employed thus are more pure than when made in comparatively small generators. The oxygen can be purchased in steel bottles now for 2 cents and less per cubic foot, and acetylene for 1½ cents; whereas, oxygen cannot be made cheaper than 3 cents by the potassium process, or 2 cents by the chlorate of calcium process, and the cost of acetylene generation will run up to 1 cent per cubic foot; not counting on maintenance, sinking fund, and additional insurance due to increased fire risk.

The portable welding apparatus comprises oxygen cylinders, acetylene tanks, blowpipe, rubber tubing, gas-pressure regulators for both gases and welding goggles.

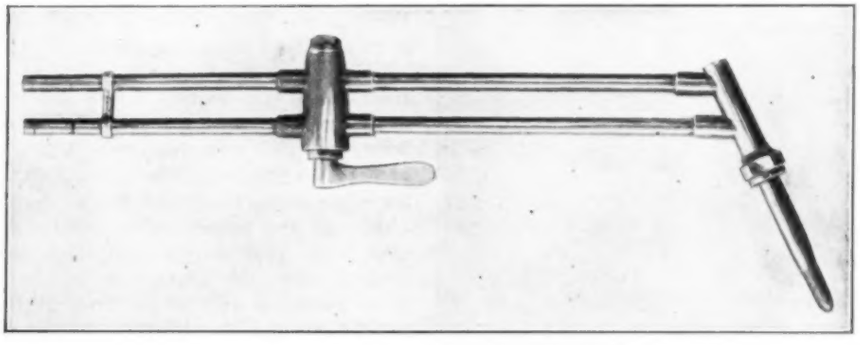


FIG. 1. NEW OXY-ACETYLENE WELDING TORCH

The oxygen bottles are of the high-pressure type (225 or 1800 pounds per square inch), and are furnished with a needle valve. The oxygen regulator, with a range of pressure from 0 to 50 pounds, is screwed on to the tank, and the rubber hose is fastened tightly with a wire clamp to the regulator and to the upper tube of the blowpipe.

The acetylene tanks are safety storage cylinders filled with asbestos and acetone, the latter one of the constituents of wood alcohol. This makes the use of acetylene absolutely safe, inasmuch as the acetone will absorb the acetylene under pressure and will liberate it by opening slowly the needle valve. At the bottom is a fuse plug, which will melt in case of fire, allowing the acetylene to escape in a small stream that will ignite and burn out the whole contents, without explosion. The acetylene regulator, with a range of pressure from 0 to 10 pounds, is screwed on to the tank; one end of the rubber tube is fastened to the regulator and the other end to the lower tube of the blowpipe.

New Welding Torch

The blowpipe, as shown in Fig. 1, is provided with two inlet tubes; the upper one being for oxygen and the lower for acetylene. Both gases are controlled by means of a double cock. To close the cock turn the handle to the left and to open it turn handle backward. The opening for oxygen is considerably smaller than that for acetylene; therefore, the oxygen can be shut off from the full open position (handle backward) by turning the handle about 15 degrees to the left, while the acetylene is not shut off until the handle has been turned 30 degrees to the left.

The head of the torch is designed so as to keep the gases separated until mixed in the tip, which is fastened by means of a union and a ground joint to the head. There are eight interchangeable tips for welding metal from 1/64 to 1 inch thick. Each tip contains a mixing chamber and an oxygen and acetylene orifice, all of which are complete in and vary with each size of tip and make the torch fool-proof. The head contains a back-flash safety device that is inserted in the acetylene channels and closes these channels in case of a back flash and any slag that may clog up the tip will be blown out.

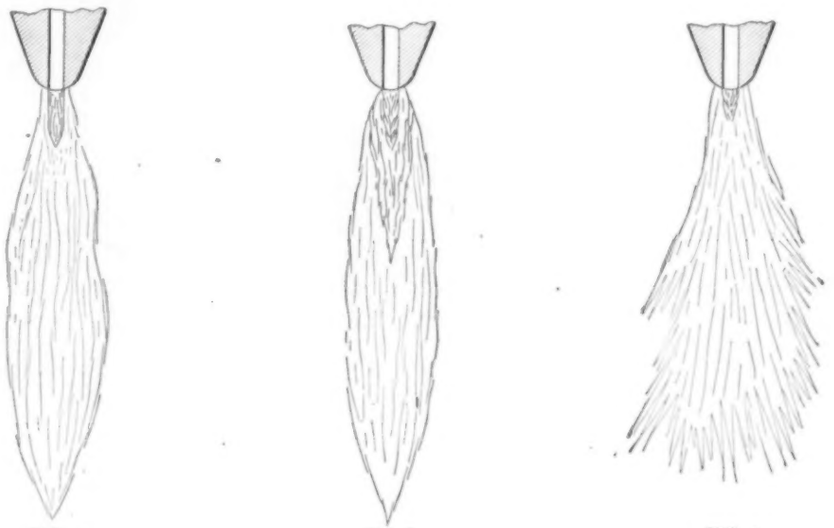


FIG. 2. Neutral Flame

FIG. 3. Flame with Excess of Acetylene

FIG. 4. Flame with Excess of Oxygen

American Machinist

OXY-ACETYLENE WELDING FLAMES

Operating the Torch

To start the operation, close the blowpipe cock and open slowly the acetylene needle valve on tank. Then hold the tip of the blowpipe toward an open flame or an ignited match and turn the regulator screw slowly clockwise, until a space of about ⅛ inch is visible between the flame and the tip. Now open the oxygen slowly and turn the regulator screw slowly clockwise, until the two cones formed by the flame unite into one small cone, which should be from ¼ to ½ inch long.

If the oxygen regulator screw is turned further in a clockwise direction, the bright cone will diminish, which means an excess of oxygen. When there appears beyond the bright cone a second, less brilliant cone, this shows that there is too much acetylene in the flame. Too much oxygen will burn the metal and too much acetylene will carburate it. The flame with the bright cone just on the point of forming the second cone is a neutral flame, which is the right flame for steel welding. Figs. 2, 3 and 4 show respectively the neutral flame; too much acetylene and too much oxygen. The flame can be easily tested, by turning on a little more acetylene, or oxygen.

Both will tend to lengthen the second cone.

The bright cone should be about 1/16 inch from the metal during the welding operation. Touching of the metal or the welding stick with the end of the tip will cause, in most cases, a back flash. If that happened, the cock must be turned off and the torch relighted again.

To stop for a short time, close the torch cock quickly and shut off the oxygen needle valve on the cylinder; otherwise the oxygen may leak through and rupture the rubber tube. For a longer stop, close, in addition to the above, the acetylene valve on tank.

The blowpipe may become overheated by working on heavy pieces, in which case turn off the gases and dip the torch in cold water.

The tip should be examined before attaching to the torch and if observed, cleaned out with a brass or copper pin as still might injure the tip.

Preheat all metals, if possible, to save gas and to equalize the internal strain. The welder should protect himself from the heat radiation of large heated pieces, by means of asbestos blankets; just leaving a sufficient opening for welding.

It is advisable for beginners to experiment for a day or two on ⅛-inch steel, which can be welded without a welding stick. The joint should be tested by breaking it. The seam may be defective, either by not welding through or by burning it. Do not experiment with various kinds of metals until the ⅛-inch steel welding is mastered. For work over 3/16 inch in thickness, chamfer the edges 45 degrees and add metal from a welding stick, after the part to be welded is in fusion, down to the bottom. The welding stick, when fusing, must be in contact with the bottom of the fused metal.

Do not use either too large or too small a tip. The proper size flame will melt the metal to a plastic condition. If the flame is too small, the radiation will chill the joint, the fusion will be very much localized, and the joint will be in most cases burned. Too large a flame will overheat the joint and will burn or even evaporate some of the chemical constituents of the metal, making the joint porous.

Welding Cast Iron

In welding cast iron, all heavy castings should be heated without warping them. After welding, cover the piece, if possible, either with asbestos or sand so it will cool slowly. For a welding stick use cast-iron rods from ¼ to ⅜ inch thick, and about 12 inches long, that are rich in silica, so as to make the weld soft. For a flux, use equal parts of borax and washing soda. In making the weld, heat the joint until fusion takes place and heat the welding stick a little and dip it in the flux; then fuse it into the bottom of the joint and every now and then dip it in the flux. Use very little flux as too much will weaken the joint and harden it. After welding, heat the surrounding metal to a red heat and the joint is finished.

Making Steel Welds

For steel the welding stick should be a good grade of soft open-hearth steel

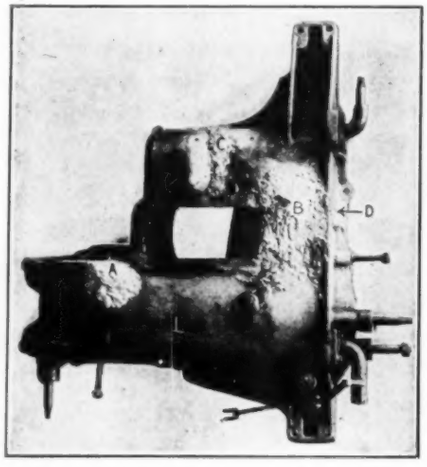


FIG. 5. OUTSIDE OF WELDED TRANSMISSION CASE

wire from ⅛ to ¼ inch; preferably Norway iron (American). The flame must have the proper mixture as too much acetylene will produce a cast iron of the best steel and too much oxygen will make it brittle and spongy. The flame should not make the steel flow like liquid, or produce a foam on the surface, as this

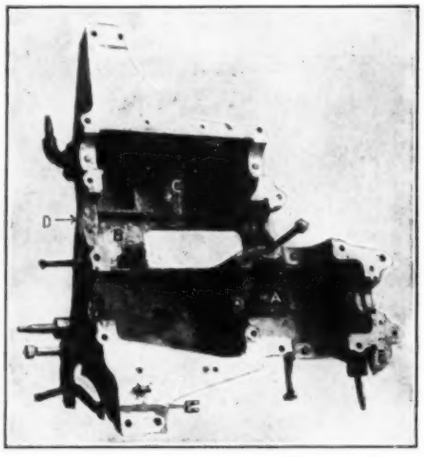


FIG. 6. INSIDE OF WELDED TRANSMISSION CASE

is an indication of burning out the chemical constituents of the steel that leaves the joint in a porous condition. The torch should be moved in a circle, removing the flame slightly after each turn and driving the metal always to the center with the flame.

When welding long joints in plates, with combined stresses of bending and tension, add about 25 per cent. of metal from the welding stick. It is also advisable to hammer all steel over ¼ inch thick with about a 1-pound round-head hammer, right after the joint is completed. Heat the surrounding metal to a red heat and hammer the joint, with rapid and light blows, until cooled to a dark red heat. Never hammer after that, as the joint may crack if the steel plates contain over 0.03 per cent. sulphur.

Steel, plates or pipes, not over ⅜ inch thick, can sometimes be butted together without chamfering the edges. In such case the edges are left apart a distance of about one-half the thickness of the metal, and the upper edge is broken down with the flame until the bottom is filled up, then metal is added from the welding stick. Overload the joint, if permissible, and hammer it.

To weld a crack in the middle of a heavy steel plate, chamfer the edges from one side, or if over ¾ inch thick, from both sides. Then heat the metal beyond the crack to a distance of three times the thickness of the plate. Thus the crack will open and the welding can be commenced.

Welding Aluminum

The welding of aluminum is the most difficult of all the metals, on account of the oxide that forms during the fusion. The melting point of the metal is only about 1200 degrees Fahrenheit, and yet we cannot unite a joint by means of an ordinary flame owing to the rapid formation of the oxide, which has a melting point of over 4500 degrees Fahrenheit. Furthermore the density of that oxide is greater than the fused metal.

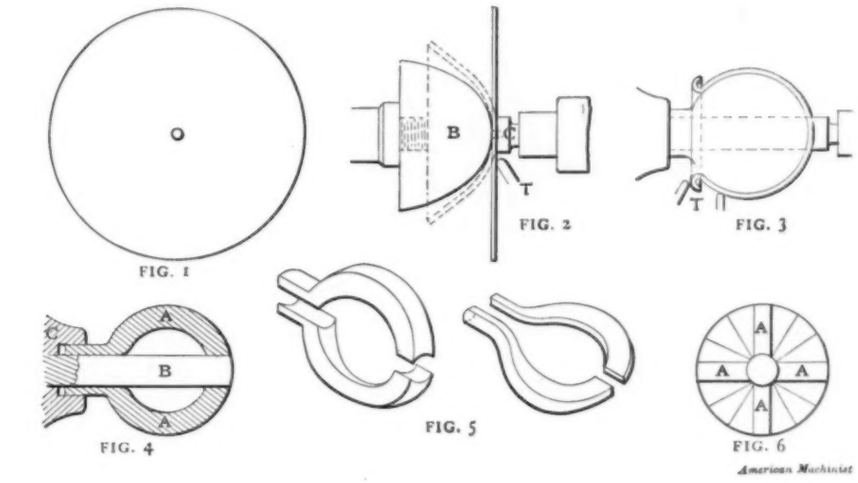
Aluminum castings should be heated to from 400 to 500 degrees before welding, to take care of the expansion. For castings over 3/16 inch thick it is sufficient to heat the joint with the blowpipe until the edges become soft and plastic, thence scrape off the formed oxide with a flat steel rod; after which concentrate the heat to make the edges flow and weld in an aluminum stick of the same quality as the casting, or better. A missing piece or lug can be welded on by making a mold of its shape from fireclay lined with asbestos. After welding, cover the casting carefully with an asbestos blanket or hot sand, to guard against cracks.

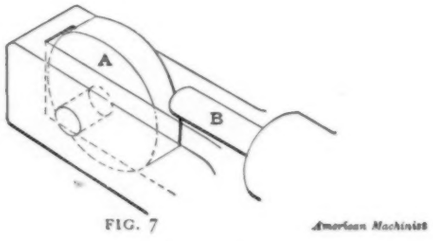
Aluminum sheets less than ⅛ inch thick are more difficult to weld. We cannot employ the mechanical method for the removal of the oxide, since we would break through the thin sheet before the joint is formed. The oxide in this case is removed by chemical means, that will lower the melting point of the oxide. The best results are obtained by using a flux, made of a mixture of the chlorides of potassium, sodium and lithium, and a small trace of fluoride of potassium. The

joint is heated with the blowpipe; the flux applied; the end of the pure aluminum welding stick heated and dipped in the flux in the usual manner to weld the joint.

In Figs. 5 and 6 is shown the outside and inside of a transmission-gear case from a 1905 Mercedes 40-45-horsepower automobile, in which a large bevel gear broke and pushed through the bottom of the case at *A*, making an oblong hole about 3½ inches long. At *B* the reverse gear is fastened and this also pushed out carrying part of the case with it. The case also split at *C* and *D* and the lug at *E* broke off short.

The case was mended, as shown, by fusing new metal into the holes formed at *A* and *B;* filling up the cracks at *C* and *D* with molten metal that was fused to the original metal in the case, and building on a new lug at *E*. This job was done at the Berger Machine Works, Brooklyn, N. Y., with the torch and apparatus described above.





SPINNING A BRASS BOWL

It took four hours to complete the job and 40 cubic feet of acetylene and 50 cubic feet of oxygen were consumed in the operation. Extra metal was allowed for strength wherever it did not interfere with working parts. The greatest difficulty to overcome in a job of this kind is to prevent new cracks from forming and a warping of the case from the expansion and contraction of the metal caused by the heating and cooling. This can only be done by preheating the case.

Spinning a Brass Bowl

We are so accustomed to the stamping of the sheet-metal work that usually we forget that spinning operations are still used in a great many instances, such as bowls, jardiniéres and in some forms of lamp bodies. As spinning is comparatively unknown, being confined to a small branch of the metal-working industry, the following sketches secured at the shop of Chadwick Bros., Hamilton, Ontario, Canada, may be of interest.

Beginning with the blank shown in Fig. 1, which is punched out in a large press, the first spinning operation is shown in Fig. 2. The blank is placed over the centering pin, which can be either on the forming block *B*, or in the revolving center *C* and not only centers the blank but also holds it firmly in position during the spinning operation. While the hole is not absolutely necessary it is usually found on any except the lightest material. The forming block *B* is usually of maple and this screws on the nose of the lathe spindle. The disk is driven by the pressure of the maple block against the revolving center *C* and the tool, having a rounded end so as to avoid all cutting action, is held on a hand T-rest in about the position shown and kept against the revolving sheet until it conforms to the contour of the maple block.

After this has been spun over to about the shape of the dotted lines, it is removed for annealing, which becomes necessary after a little working as the sheet brass becomes quite brittle from the surface tension or temper produced by the pressure of the tool.

The Forms Used

Before considering the final spinning to shape it will be better to have a look at the forms used and the way in which they are constructed. The shaft *B*, as shown in Fig. 4, projects from the chuck, which has an annular opening to receive the end of the pieces *A A* that go to make up the form.

These forms are constructed of a number of pieces as shown in Fig. 5, which go together something as indicated in the end view in Fig. 6, using the shaft *B* as a center and being held in position by the annular grove in the chuck *C*. After these have been assembled around the shaft *B*, the annealed blank which has been partially spun is again placed in the machine and forced to conform to the outline of the form inside as indicated in Fig. 3. The rolled-over lip is made without any special form being provided, by the careful manipulation of the spinning tools.

It is necessary to have the forms contain a few straight-sided pieces as *A A A A*, Fig. 6, for as soon as the piece is finished the tail center is drawn back and the whole thing pulled off the shaft *B*. If all the cuts were radial it would be impossible to take out the pieces which go to make up the form, but by having several pieces with straight sides which can be readily tipped toward the center and removed this is overcome.

After the straight-sided pieces are picked out it is easy to remove the others from the inside of the bowl, and after this is done they are easily reassembled on shaft *B* so as to be in position for the next bowl.

A Novel Step Bearing

Fig. 7 shows an interesting step bearing on a number of these spinning lathes. A hardened pin *P* extends from the back end of the lathe spindle and rests against the hardened steel wheel *A*, which is mounted in the extension bracket at the back of the headstock, as shown in outline. It will be noticed that the spindle point *B* is a little above and to one side of the center of the wheel *A* so that it imparts a very slow rotary movement to the wheel, which constantly brings a new surface into contact with the end of *B*, and distributes the wear in a very satisfactory manner. This form of step bearing is said to be giving very good results and is one that can be easily made or renewed.

What will probably be the most important aviation meet in this country this winter is scheduled to take in Los Angeles, Cal., from January 10 to 20. At a recent meeting of the directors of the Aëro Club of America it was decided to sanction this meet insofar as would conform to the rules of the International Aëronautical Federation. This aviation meet will probably be held under the auspices of the Aëro Club of California, which will be responsible for it and make such provisions to insure the various prizes and conditions being carried out as advertised on entry blanks.

Cylinder Work in the Pierce Shops

The milling machine illustrated is one of the best examples we know of showing the development of special machinery for use in automobile work and the way in which expensive tools are designed and built for one particular operation. This is a new nine-spindle milling machine in use in the Pierce Arrow Motor Company's shops in Buffalo, N. Y. Fig. 1 shows a cylinder being operated on by nine milling cutters. As can be seen these are all solid mills with the exception of the two outer cutters, even these having a solid mill on the inside, projecting below the inserted tooth cutters for reaching a surface that is below the surface reached by the inserted-tooth mill. The fine thread on the ends of the milling-machine spindle quills shows how the end adjustment of the spindles is secured and maintained by the lock nuts, which are also used at the other ends of the quills. This allows very fine adjustment in setting up the machine.

The action of the milling cutters is very plain, the lower pair milling the sides of the cylinder base, the next pair both the sides of the cylinder and also the faces of the lower end of the valve-chamber opening. Guards are provided on the two lower pairs to keep the chips from the milling cutter above working into the end of the bearings. We understand that the idea of using a milling machine in this way and for this work originated with Messrs. Cook and Guider of the Pierce plant and that the details were worked out and the machine built by Beaman & Smith, Providence, R. I.

The cylinders to be milled are mounted on substantial and ingenious fixtures shown in Fig. 2. Fig. 2 shows the table of this machine, also a view of the cutters at the extreme right. The uprights on the fixture fit the first bore in each pair of cylinders, which are located both from the bore and the dowel pins shown in the face of the fixture. The clamps are thrown out of the way or removed as the case may be and the cylinders placed over these columns and located by the dowels. At the top of the column is a split bushing which expands into the bore of the cylinder and any further movement tends to draw it down nearer to the base.

The six clamps shown hold the base firmly to the fixture which in this way is enabled to withstand the strain imposed by feeding the work against the nine cutters at once. This insures duplication and also indicates very clearly that no radical change in cylinder design is contemplated in the near future.

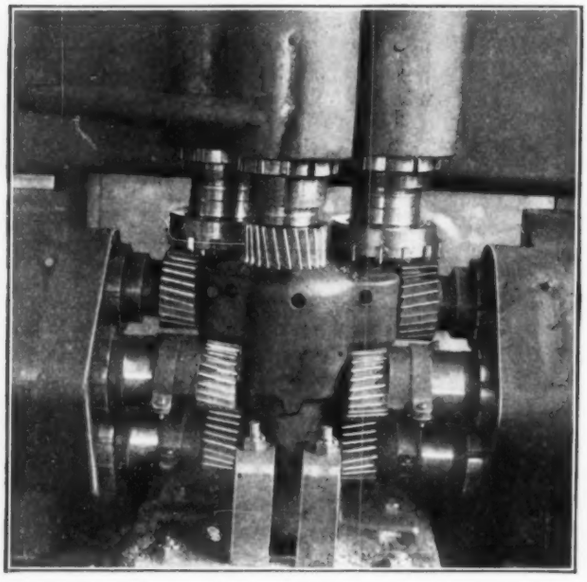


FIG. 1. MILLING A CYLINDER WITH NINE CUTTERS

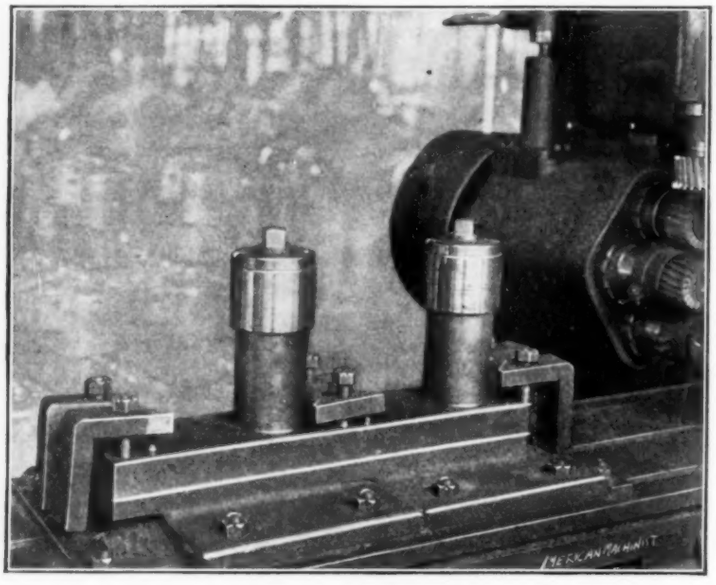


FIG. 2. THE FIXTURE FOR HOLDING CYLINDERS

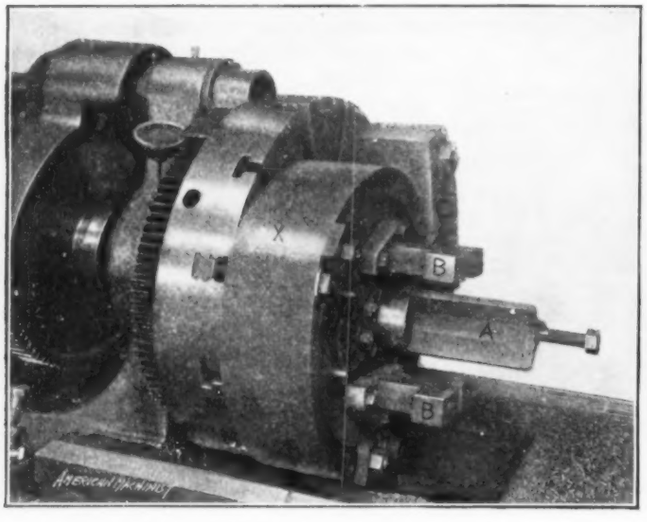


FIG. 3. FIXTURE FOR BORING VALVE CHAMBERS

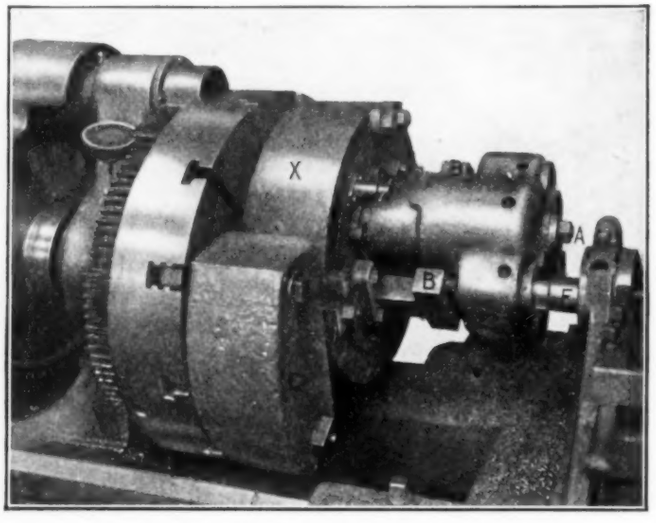


FIG. 4. VALVE CHAMBER BEING BORED

Boring Valve Chamber Holes

Instead of boring the valve chamber holes under a drill plant or some similar way by means of a jig they are taken to a large Gisholt machine which has the fixture shown in Fig. 3 mounted on its spindle. This consists of a substantial body casting *X*, which carries an inner circular piece on which is mounted the three-lobed piece *A* for centering the bore of one cylinder of the pair, the tool-bar supports or guiding holes *D D* and the dowel pins *B B*. The lead counterweight *C* simply balances the overhang of the whole fixture so that it may be run at a reasonable speed.

In Fig. 4 a pair of cylinders is shown mounted on this fixture, being held against the central piece by the bolt and washer on the extension of *A*. One valve chamber is being bored and the way in which the end of the boring bar is supported in *B* can be clearly seen. After this hole is bored the indexing pin used locates the central piece carrying the work in a new position so that the next valve chamber can be bored in the correct position. This also shows the counterweight *C* more clearly and gives an idea of its substantial proportions. This fixture can be readily used on a vertical mill should it be found desirable at any time.

F. H. C.

Automatic Temperature Control Instrument

By E. F. Lake

The latest thing in the heat-treatment of steel is the machine for automatically controlling the temperature of furnaces that is shown in the following illustrations. This is a very ingenious device that has been designed and perfected by the American Gas Furnace Company and it has taken several years of study, experimenting and labor to overcome the many difficulties that presented themselves.

As pyrometers are required for measuring the high temperatures that are used in heat-treating steel in order to make an instrument that would accurately control the temperatures inside the furnace, it became imperative to start operations from the pointer that indicates the temperature. This was the most difficult proposition as the pointer must be left free to oscillate back and forth as the temperature rises or falls in the furnace. Anything that would retard the action of this pointer would soon throw the pyrometer out of true and ruin it for accurate temperature readings.

At the same time it was necessary to have power enough to instantaneously open and close the gas and air valves that admit this fuel to the furnace. The mechanism also had to be positive in its action in order to control the temperature within 5 or 10 degrees of a given point. And to make it practically useful, it was necessary to make the instrument as near fool-proof as possible. These things have all been accomplished in the instrument shown attached to the furnace in Fig. 1, and the apparatus has added a much needed improvement to the hardening room.

In Fig. 1 the thermo couple, or hot end, is inserted into the furnace at *A* and connected to the recording indicator *B*.

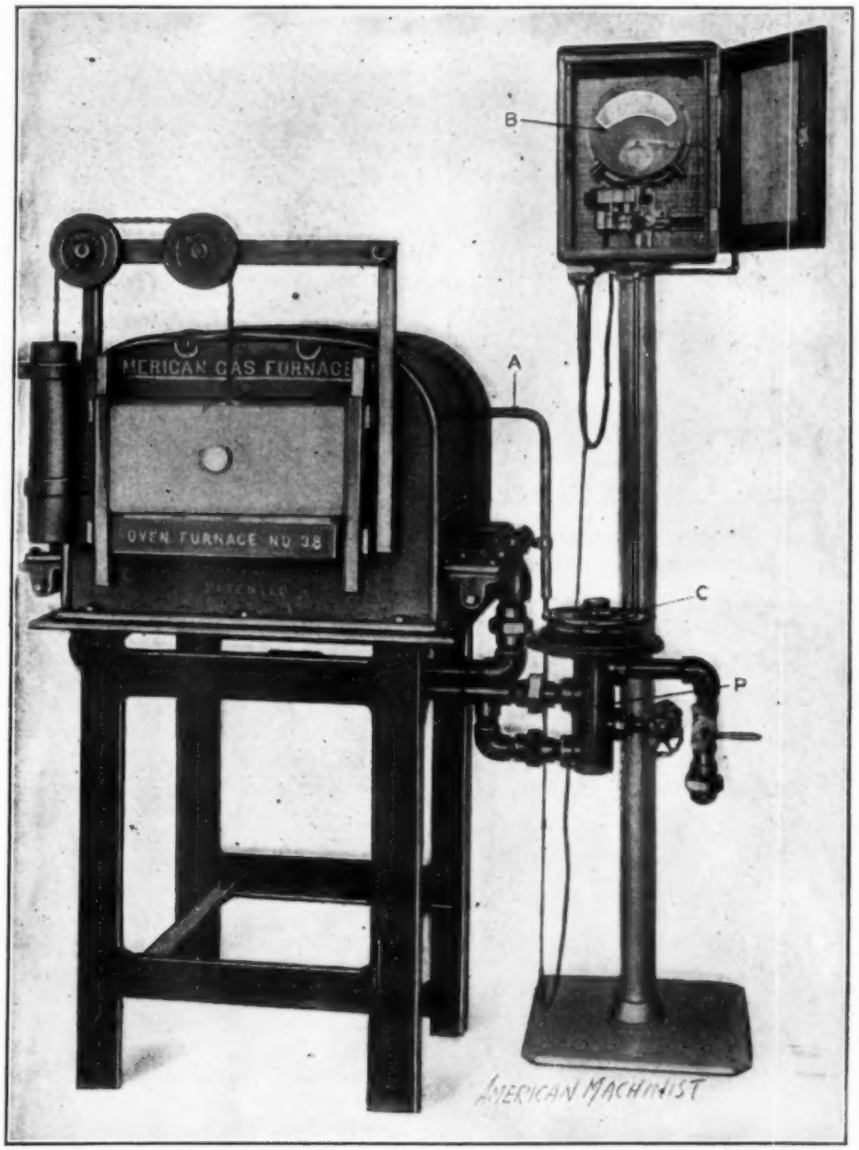


FIG. 1. INSTRUMENT FOR AUTOMATICALLY CONTROLLING TEMPERATURE OF FURNACES

Underneath this in the case, is the apparatus that controls the mechanism that opens and closes the valves, and at *C* is located the valve opening and closing mechanism. The case is supplied with a lock so that the instrument cannot be tampered with when it is once set for a given temperature. The mechanism of the instrument is propelled by a small current of air that is taken from the same supply that furnishes the furnace with its blast.

The case containing the temperature indicator and the temperature-control operating mechanism is shown on a larger scale in Fig. 2. At *D* is located a thumb screw that revolves the disk *E* and moves the pointer *F* with its arms *G* to the temperature at which it is desired to maintain the furnace. The arms *G*, as well as the rest of the mechanism, are operated by power supplied from a fan located in the case *J*. This is revolved by a current of air that is sent through a ¼-inch pipe and blows against the blades of the fan.

How the arms *G* operate is best shown by the drawing, Fig. 3, which is a view that looks down on their top. When the temperature rises in the furnace, the indicator pointer *I* travels to the right until it passes under the left-hand arm *G*, which is now stationary, and comes in contact with the right-hand arm *G*, which is constantly oscillating in and out of the slot *H*. When it arrives at the position shown the right-hand arm *G* grips it for an instant, and this trips the arm and throws it back to the position shown by the left-

hand G so that the indicator pointer I will pass it and register any rise in temperature which may occur after this, due to the lag.

When the right-hand arm G is thrown back to the stationary position, the left-hand arm G is started oscillating in and out of the slot H by means of a cam and the valves that admit the gas and air into the furnace for fuel are shut off, thereby stopping the heat. Then, as the furnace cools, and the indicator pointer I travels back to the left to record the lowering temperature, the left-hand arm G catches it, trips, turns on the gas and air and the right-hand arm G starts operating.

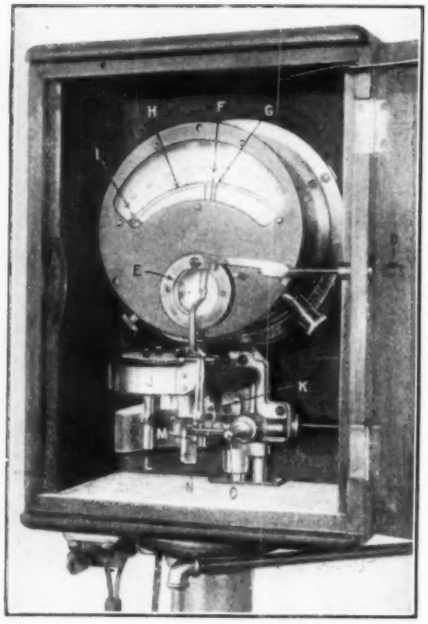


FIG. 2. APPARATUS CONNECTED TO THE INDICATOR

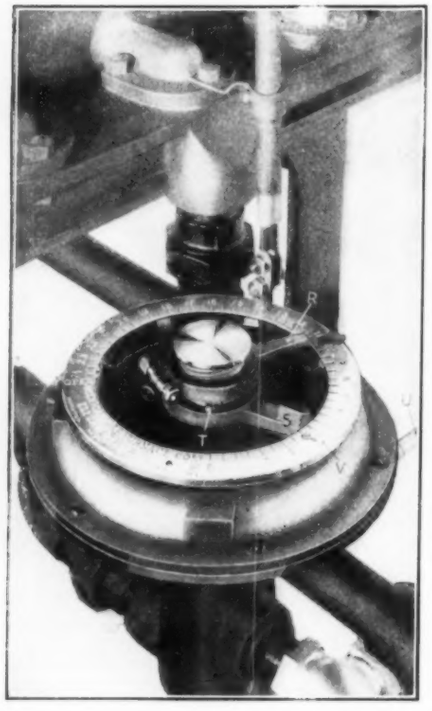


FIG. 5. APPARATUS CONNECTED TO THE FURNACE

The arms G are given their oscillating motion or held stationary by the lower end riding on two disks K that alternately act as cams and are fastened together, as shown in Figs. 2 and 4. The disks K are moved back and forth on their centers by the piece L which is moved back and forth the distance of the opening M. The piece L rides on the bar N for one-half of this distance, and for the other half, the half round in the top in the opening M drops over the bar N and moves it back and forth to oscillate the disks K. While doing so, the end of bar N rides on a flat spot in the valve rod O, but when one of the arms G is tripped and the other starts operating, the end of bar N pushes in or out the valve end O and opens or closes an air valve that sends a current of air into a diaphragm, or cuts it off, that is located in the lower part of the apparatus shown in Fig. 5. As will be seen in Fig. 4, one of the G arms is riding on the cam of the disk K and is therefore in motion while the other G arm is riding on the outer circle and is therefore stationary.

In the lower part of the apparatus two square holes are provided in the cylinder P, Fig. 1, to act as openings for the air and gas to pass through, and over these is a plate that raises and lowers to open and close them. The amount that these can be opened and closed is regulated by moving the arms R and S in Fig. 5. These move the center rings up or down on a screw and they can be clamped to it by the set screws back of the arms, when the proper amount of motion for the valve slide is decided upon. The pin T is connected to the slide and allows it to be moved from the top to the bottom ring by the air that is admitted to or shut off from the diaphragm through the pipe U.

One point on the arbitrary scale on the disk S means a motion of 1/64 of an inch for the valve slide, and when the arm R is placed at the "open" mark and the arm S at the "shut" mark, the air and gas passages can be opened or closed by the slides traveling their full distance. This is seldom done, however, as the furnace can usually be regulated by turning on or shutting off a part of the heat.

This apparatus has been tested out for some time at the company's plant and has proved itself efficient and practical. Therefore, it promises to fill a long-felt want in the furnaces for heat-treating metals, as anyone who operates furnaces knows how difficult it is to keep the temperature at a certain given point by hand-operated valves. While the designing of the instrument was a difficult problem, the results have been accomplished in a comparatively simple manner, and the machine will doubtless have a future with those that require absolute accuracy in the annealing, hardening and tempering of steel.

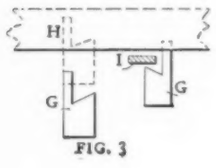


FIG. 3

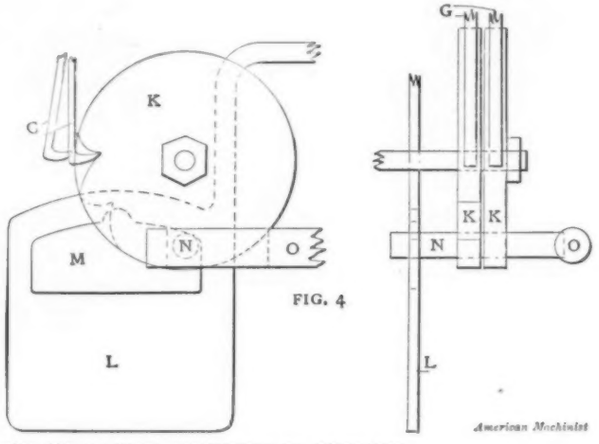


FIG. 4

OPERATING MECHANISM CONNECTED TO INDICATOR

An electrical floating dock of 11,500 tons capacity is located at Hoboken, near Antwerp, in Germany, according to *The Inventive Age*. The dock has seven centrifugal pumps directly coupled to electric motors, and these high-speed pumps are so powerful that they can raise the loaded dock in ninety minutes. It has a total weight of 4300 tons, and is constructed in two sections, one having four, and one three pontoons, carrying the two side walls which measure 30 feet in hight. The total lifting capacity is 23,000,000 pounds. One of the sections is 277 feet 9 inches long and the other is 207 feet 8 inches long, and the hight of the pontoons is 12 feet 10 inches, while the total width of this enormous floating dock is nearly 100 feet. It is equipped with a most complete electric installation, arc and incadescent lamps, numerous motors for operating electric machine tools, hoisting apparatus and other labor-saving devices.

AMERICAN MACHINIST

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December 9	26,500
December 16	24,500
December 23	24,000
December 30	24,000

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None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Public Trade Schools

We regret to note from the report of the recent Milwaukee meeting of the National Association for the Promotion of Industrial Education that the interest of manufacturers in the association is waning and that, as a consequence, the professional educator is gaining the ascendant in the activities of the association, with the result that the influence of the association is directed more and more exclusively toward the public-school system as the proper channel through which the problem is to be solved, the plan in contemplation involving the organization of a vast system of trade schools supported at public expense.

In addition to expressions of opinion, which through indirectness are scarcely quotable, but which are subject to no interpretation but this, a few direct quotations will indicate the trend of the papers read at the recent convention. Thus we find "industrial training will inevitably add to the cost of public education. The equipment of industrial schools is more expensive than for other kinds, the material used in hand work must be paid for, and the teachers cannot be hired at the wages now paid to grade teachers in the public schools."

"Industrial education means the redirecting of our public schools, adapting them to the needs of our people from an economic as well as from a social standpoint. No trade schools or agricultural schools have been successful without Government or State aid." [A statement with which we take direct issue.]

"The control of industrial education should be in the hands of existing State boards of education."

"It will be found that the cause of vocational training will be speedily hastened and perfected by each city establishing as soon as possible its own trade school."

"That such education must be under the control of public-school boards is a foregone conclusion to all who value democratic control of education."

We are far from desiring to appear as antagonizing the movement for the introduction of trade schools supported at public expense. There are no doubt localities in which such schools are justified; indeed, we already have examples of them which are undoubtedly successful, and we have nothing but commendation for any community which will tax itself for the support of such schools. With the proposition that they be administered by the existing public-school authorities, however, we have no sympathy and would, in fact, look upon such action as inviting nothing less than disaster.

There is no body of men more incapable of handling trade schools successfully than existing boards of education. This is recognized by many who thoroughly believe in public trade schools, although outside the ranks of professional educators. An illustration of this is found at Worcester, Mass., where it is no secret that a stiff and successful fight was waged by those promoting the new trade school at that place in order to completely divorce it from the existing public-school system of the city. The Milwaukee school is now a part of the public-school system, though to just what extent control by the public-school board extends we do not know, the significant fact being that the school was organized and its bent given to it before it was taken over as part of the public-school system.

While admitting a field for public trade schools, their lack of ability to completely solve the problem is sufficiently shown by the fact that in the nature of the case pupils attending them can earn nothing when doing so, while through the corporation-school plan as now carried on by the General Electric Company, the Westinghouse Electric and Manufacturing Company and the New York Central & Hudson River Railroad Company, the apprentices earn regular wages as a matter of course, while under the coöperative plan, as carried on in Fitchburg, they earn enough for partial self-support.

Many parents are able and willing to send their boys to public trade schools under these conditions, but many others are not. With large numbers the necessity for earning a living is paramount and for them the corporation and the cooperative schools offer the only broad solutions of the problem which have been proposed.

The ideas of the professional educators are too much in the clouds. They ignore controlling conditions and aim at an ideal solution, instead of, as they should, searching for a solution which will accomplish the greatest good for the greatest number.

The most surprising part of the program is, that with the large opportunities for the public-school system, opened up by the coöperative system, it received so little attention in the proceedings. The public-school authorities have enough in this to keep them fully occupied for a good while to come. The plan meets actual conditions in far larger measure than any solution offered by them and it offers a field of work for the public schools of the appropriateness of which no one can hold a doubt. In preparing themselves to do their part of the work properly, there is a large program laid out for public-school teachers and the most useful thing they can do is to equip themselves for it, instead of arrogating to themselves the control of things for which they are not fitted and proposing plans the magnitude and expense of which stagger the imaginations of all but themselves.

The Treachery of Memory

We frequently note statements from lawyers, judges and others having to do with the testimony of witnesses, showing how little reliance can be placed, under certain conditions, upon that peculiar, little understood reconstructive action of the human brain, called memory. If but little reliance can be placed upon the memory in regard to incidents and happenings that should be fixed in the mind, what shall be said of memory when its action is associated with that action of the brain that creates?

Many bitter disputes have arisen between rival inventors who were associated on a given problem; both have claimed the honor of prior conception; both were perfectly honest in believing that the credit was theirs and that their opponent was mistaken. Bad feeling frequently arises between foreman and workman, or between chief draftsman and designer because the one believes that the other is seeking credit for something that is not his idea. In all such cases, unless there is documentary proof, it is wise to consider the treachery of the individual memory, before accusing anyone of appropriating ideas of another.

Two incidents have a direct bearing on this situation. A certain inventor was in the habit of keeping careful notes of his ideas and having these notes signed, dated and witnessed by some one of his assistants. Several times in the case of one of these assistants, the young man brought sketches of devices and inventions that seemed very familiar to his chief. Search through the note books showed that some little time before the assistant had witnessed essentially the same device. Memory failed to recall the device to the young man's mind as something that he had seen, but it was suggested as something new, a discovery, an invention.

Here is a similar case in the experience of the same inventor, but with another man, a partner. This partner developed, as he supposed, a new invention in considerable detail and presented it for consideration. The inventor then produced one of his own patent applications signed some three months before by the partner as witness and disclosing the same device. Again memory had proved treacherous. In all these cases both men were perfectly honest in believing that the inventions were theirs until documentary proof showed otherwise.

Thus when a possible controversy is in sight over the originating of an idea it is well to stop and ask oneself, "Am I positive that I conceived that idea or has my memory played me a trick, and have I seen that device somewhere and forgotten the incident? Have I any written proof to substantiate my claims to that idea, or is my unaided memory the only basis of my belief that it is mine?"

Cincinnati Metal Trades Meeting

The Cincinnati branch of the National Metal Trades Association had a very interesting meeting at the Business Men's Club December 15, including besides resident members of the association and invited guests, a large number of students from the engineering department of the Cincinnati University and a number of apprentices from the Continuation School, recently inaugurated there.

Dr. Wm. H. Tolman gave a most instructive illustrated lecture upon "Safety Appliances," showing the movement for the better protection of workmen; the number of men killed and injured by failure to provide tested safety appliances being startling.

M. E. Bartlett, was to speak on "Cooperation," but was unable to be present because of illness.

C. H. Norton, of Worcester, Mass., talked on "Cylindrical Grinding," and also gave his fellow manufacturers some valuable points on their coöperation with inventors, designers and tool builders. Mr. Norton spoke in regard to some features of modern cylindrical grinding that are not thoroughly understood. He gave also an explanation of the construction of grinding wheels. He stated that if the removal of so many pounds of steel in a given time was the object, then grinding would not be economical, but that as we all know the object is to produce accurate diameter and a reasonably perfect surface, and that if a limited amount of material is to be removed for this purpose the grinding wheel proves the most economical.

He also made a plea for more helpful coöperation of the metal-trades manufacturers with the inventor, designer and tool builder, because these latter have not the choice the metal manufacturer has. He believes in a more kindly coöperation with a view to making both sides stronger and more successful. He contended that manufacturers could not afford to dispense with the enthusiasm of the inventor, designer and tool builder, and that they should not be discouraged by any cold-blooded thoughtlessness.

President Kirby, of the National Association of Manufacturers, President Eells, of the National Metal Trades Association, Dean Schneider, Mr. Davis and Fred Geier also addressed the meeting.

Obituary

Alden Sampson, 2d, of the Alden Sampson Manufacturing Company, Pittsfield, Mass., died on December 3, 1909.

Joseph Campbell, president of the Diamond Saw and Stamping Works, Buffalo, N. Y., died on November 26, 1909.

Charles A. Dudley, chief chemist for the Pennsylvania Railroad Company, and a widely known metallurgist, died at his home in Altoona, Penn., December 21. A graduate of Yale, and a doctor of philosophy, Doctor Dudley was recently elected president of the International Society for Testing Materials at the meeting held in Copenhagen a few months ago. Doctor Dudley was one of the first to recognize the injurious effects of copper in steel, and as a result of elaborate tests on the subject he drew up specifications limiting the amount of copper in all steel purchased by the Pennsylvania Railroad Company to 0.04 per cent. It was also as a result of Doctor Dudley's investigations that his company engaged in the manufacture of its own rails in order to secure a product in conformity with his ideas. Doctor Dudley was a member of the Iron and Steel Institute, and president of the American Society for Testing Materials. He was 68 years old.

Personals*

Joseph A. Dalton has severed his connection with the Pawtucket Tool Company, Pawtucket, R. I.

P. M. Haight, treasurer of the Sprague Electric Company, has recently been elected president of the Electrical Trades Society of New York.

W. K. Millholland, until recently secretary of the International Machine Tool Company, Indianapolis, Ind., has formed the W. K. Millholland Machine Company, Indianapolis, Ind., of which he is president.

Adolf O. Austin, until recently chief draftsman with the Star Engineering Company, New York City, has accepted a position with the Vilter Manufacturing Company, Milwaukee, Wis., as assistant engineer.

William A. Keirn, in charge of the publicity department of the Mesta Machine Company, Pittsburg, Penn., has also become purchasing agent of that company, succeeding Frank L. Thompson, recently resigned.

C. J. Kryzanowsky, who was formerly manager of the gas-engine and producer department of the Olds Gas Power Company, has recently become chief engineer of the Reliance Motor Truck Company, Owosso, Mich.

George L. Crook, formerly manager of the gas-engine department of the Atlas Engine Works, Indianapolis, Ind., has become connected with the E. M. F. Company, Detroit, Mich., acting in the capacity of factory manager.

E. E. Arnold, formerly superintendent and chief engineer of the plant of Farrar & Trefts, Buffalo, N. Y., previous to which time he was with the Westinghouse Machine Company on the engineering staff, has become chief engineer of the Metal Products Company, Detroit, Mich.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

New Colburn Boring Mill

The Colburn Machine Tool Company, of Franklin, Penn., has brought out a new line of vertical boring and turning mills in five sizes, 42-, 48-, 54-, 60- and 72-inch swing. With the exception of the method of driving the table, the same features are incorporated in all sizes. All sizes are built with two swivel heads, and the three smallest sizes with turret heads as desired.

The table spindle has a self-centering angular thrust bearing in addition to a large straight upright bearing to resist vertical, angular and horizontal strains. All bearing surfaces of the spindle are lubricated from one sight-feed oil cup, the proper hight of the oil being shown by a mark on the glass. The lower part of the cone is immersed in a reservoir of oil and as the spindle starts to revolve, the oil is carried upward to the outer edge of the bearing and into an annular channel from which it is returned through grooves to the main reservoir again, being automatically flushed with oil, which flows over into the upright bearings.

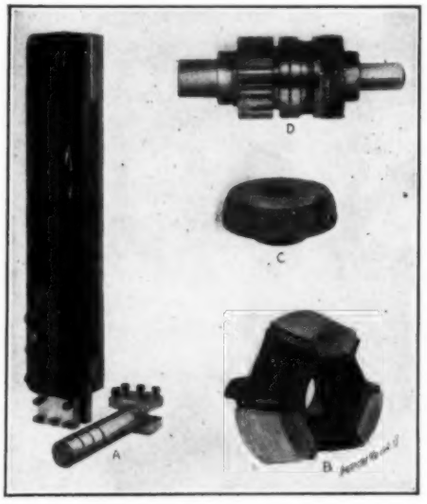


FIG. 3. SOME OF THE DETAILS

The table is driven by a spur gear of large diameter attached directly to the table itself, an external spur gear is used on the three smaller, and an internal gear on the 60- and 72-inch machines.

The drive is by means of large five-step cone pulleys, through the speed box, which contains the back gears and positive clutches which are constantly immersed in a bath of oil, these being operated by lever *Z*, giving ten speeds in all in geometrical progression. The speed box when assembled is oil tight and the hight of oil is shown by the sight-feed oil cup on the outside. All the bearings have phosphor-bronze bushings, and ring oilers for additional protection against heating. The speed box can be quickly removed from the machine for repairs, and every part is then easily accessible.

The belt shifter, as in Fig. 2, is very effective and easily operated with one hand, allowing the belt to be changed from one step of the cone pulley to another very rapidly and without injury to the belt. In actual operation the entire range of speeds obtained with the

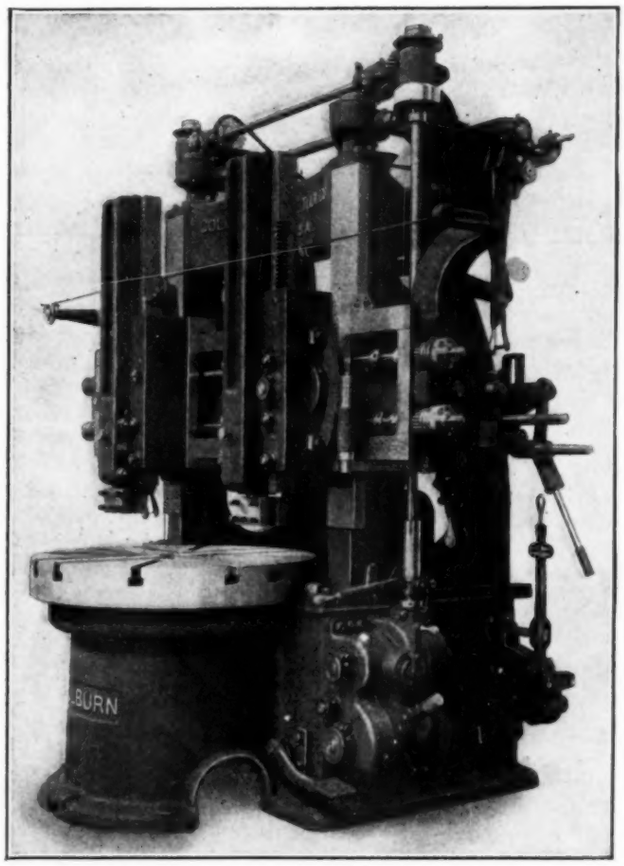


FIG. 1. 42-INCH COLBURN VERTICAL BORING MILL

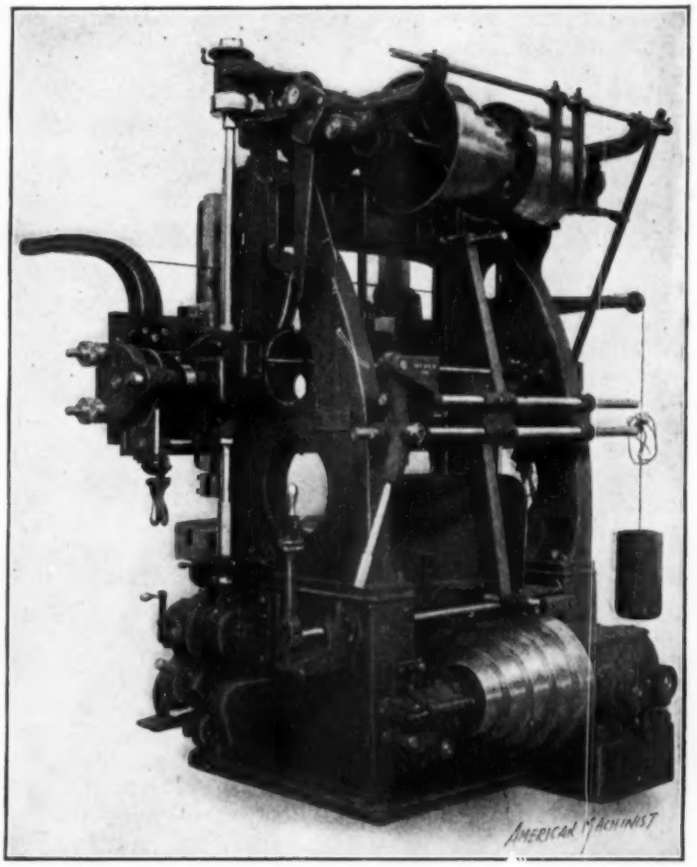


FIG. 2. REAR VIEW SHOWING DRIVING MECHANISM

cone pulleys, from the slowest to the fastest and back again, stopping momentarily on each step, has been made in 8 seconds. By changing the back-gear lever *Z*, five additional speeds are obtained. The speed index plate is located on the housing directly above the back-gear lever, and indicates the right step on cone pulley for belt and the position of clutches inside of speed box to give the correct speed of table in revolutions per minute.

To enable the operator to stop the machine with the table in any desired position, a friction brake is furnished which is operated by foot treadle placed within easy reach at the operating side of machine. The brake is applied to the inside of the lower driving cone pulley by means of a taper friction with hard maple shoes or wedges. All controls are so placed that the mill can be stopped and started, all the table speeds changed, back gears thrown in and out and the foot brake applied without the operator leaving his position at the side of the machine.

The cross rail is of the box type, with deep arched back and of massive proportions. It is raised and lowered by power. The swivels are of large diameter with broad bearing surfaces, and have five large clamping bolts. Angular adjustments are made by worm and gear which act as a positive locking device. The rams are heavy and have steel racks set into their sides. Cored openings extend clear to the top so that extra-long boring bars can be used.

The feeding mechanism for each head is contained in a separate case, one on each side of the mill. Turning the handwheel one revolution gives five changes of feed. A movement of the multiplying lever changes the combination of gears, and another revolution gives five more changes. The usual slip gears on the ends of rods and screws are eliminated, and quick-adjusting positive clutches are substituted as in *D*, Fig. 3, which enable the operator to instantly change feed from vertical to horizontal and *vice versa*. Either feed can be reversed instantly by the feed-reverse lever shown at each end of rail.

Rapid traverse of the tools, horizontally, vertically, and in angular directions is obtained from the same vertical shafts as the feed, the manipulation being by a vertical lever attached to the front of the feed case. This is so arranged that one position gives the geared feed and the other the quick traverse so that it is impossible for the operator to throw the rapid traverse in the wrong way.

Both feed screws and rods in the cross rail are splined and each has a drilled collar which fits the spline so that the rods and screws are easily turned by a small rod as in Fig. 4. With this device the operator can stand close to his work and by placing the collars in the most convenient place, make the finest adjustments of the tools in any direction without leaving his position. When the heads are moved out on the end of cross rail these collars slide back behind the heads.

When cutting threads the feed-change handwheel is set so that the vertical feed shaft and table revolve in unison. A single tooth clutch on the lower end of this shaft insures the threading tool always catching the thread in taking successive cuts, and the rapid traverse device is used to return the tool quickly to its starting point. This attachment is not furnished regularly, but can be put on at any time. For drum scoring, special arrangements are made, which allow leads as coarse as one turn in two inches to be cut as readily as the finer pitches.

A constant-speed motor is recommended for these mills, as the mechanical belt shifter and clutches in the speed box give all the changes of speeds desired. The motor is mounted on a bracket at the rear and belted to pulley on the countershaft. A clutch enables the operator to stop and start the mill without stopping the motor and is operated by the same levers with handles on both sides of mill.

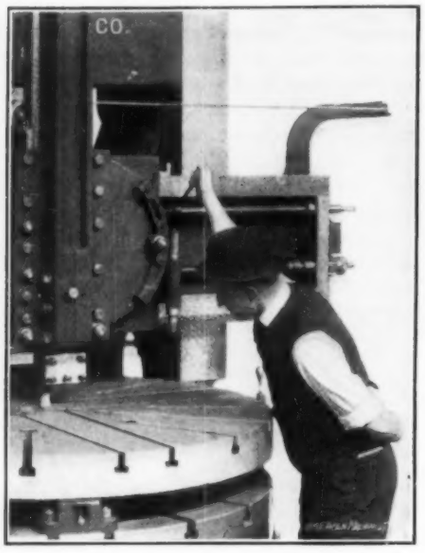
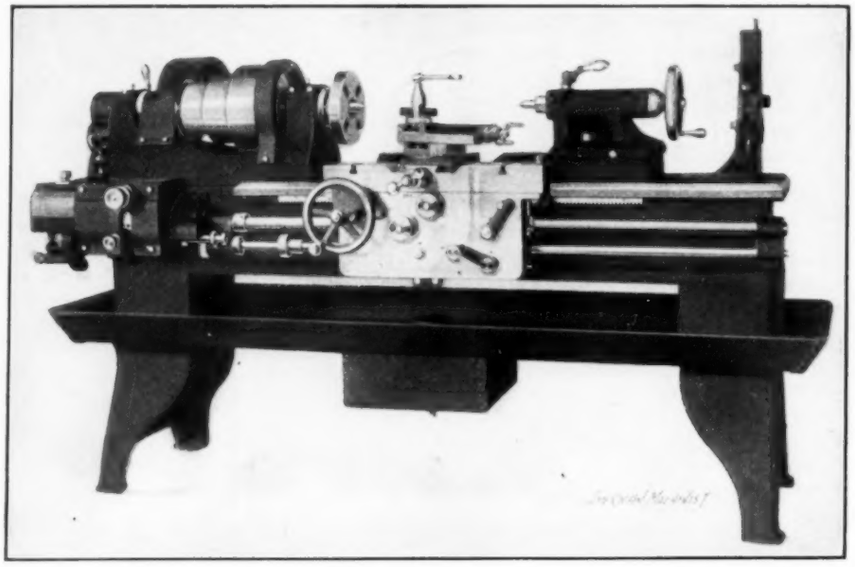


FIG. 4. FINE ADJUSTING COLLARS

Sixteen Inch Cincinnati Lathe

The illustration shows the 16-inch size of engine lathe built by the Cincinnati Lathe and Tool Company, of Cincinnati, Ohio, as equipped with the Emmes quick-change feed-gear box, which gives forty changes without duplication and does not require the removal of a single gear. All the gears are made from bar stock, bronze bushings being used on all which run loose on the shaft. This gear box allows changes to be made while the lathe is under the heaviest cut. The lathe is built with either a five-step cone, single back gear or a wide three-step cone, with double back gear and a two-speed countershaft. This gives twenty spindle speeds for the former and eighteen for the latter. The spindle is hollow, having a front bearing 2¾x5¼ inches and a rear bearing of 2 7/16x4¼ inches, which gives an idea of its substantial proportions.

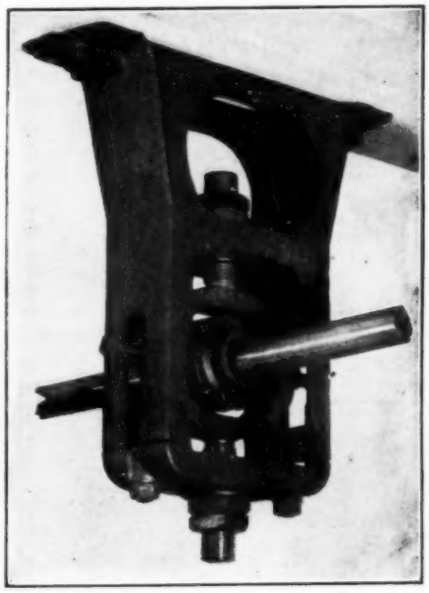
These lathes have been designed for the heaviest work and are used regularly in reducing diameters ⅞ of an inch in fifty-point steel, with 1/32-inch feed and a cutting speed of 60 feet per minute. At the same time it has been the aim of the designers to avoid making them clumsy or inconvenient.



A NEW CINCINNATI ENGINE LATHE

A Ball Bearing Hanger

In most cases where ball bearings have been adopted for use on line shafting, it has been necessary to utilize the standard hanger so as to get in the ball bearing to the best advantage. In too many cases this does not give satisfactory results and to overcome these defects the Hess-Bright Manufacturing Company, Philadelphia, Penn., has designed the hanger shown in the accompanying illustration, especially for this work. The usual ribbed section has been abandoned and the adjustment allowed the ball-bearing proper



BALL-BEARING HANGER

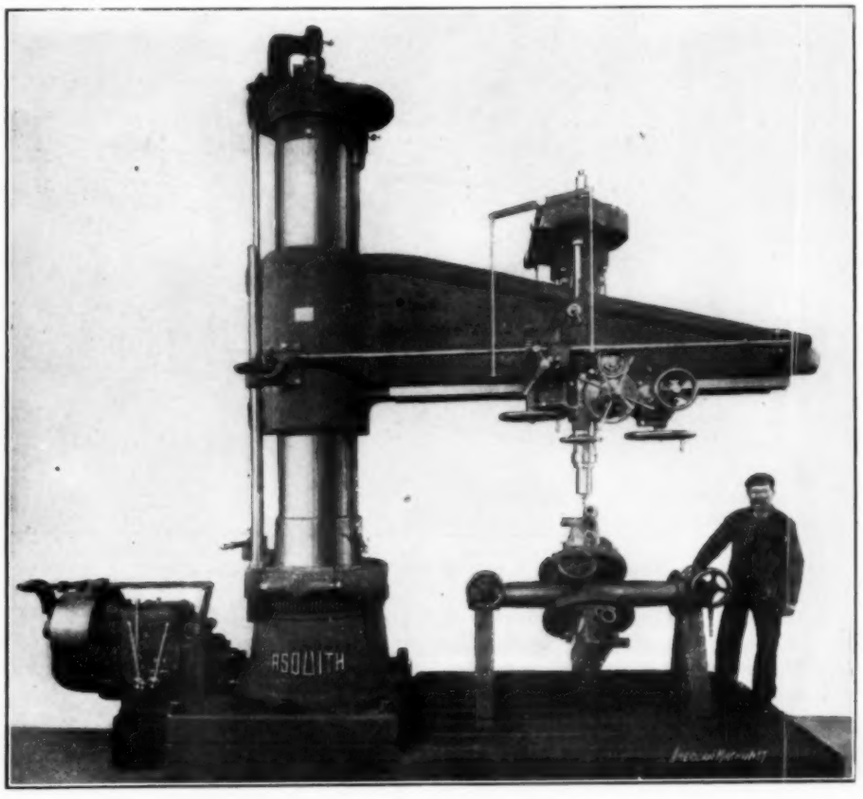
to secure perfect alinement in all directions.

This construction allows 2 inches vertical adjustment and half this amount sideways which is ample for any ordinary condition. The cap is held in place by two T's or straddles, both of which are easily removed by simply loosening the nut, and the whole construction makes it easy to erect and adjust. These hangers are designed to withstand any belt pull required by modern practice and are built in five sizes which will cover practically all demands in this direction.

An English Radial Drilling Machine

The radial drill shown herewith is of different design than is common in this country, having the drilling head bear on the under side of the arm, with the drill spindle in a central opening, which extends nearly the length of the arm, so that the upward thrust is central with the arm itself, instead of being on one side. This is a very large machine, the arm being 9 feet long and the drilling spindle 3¼ inches in diameter, with a vertical feed of 20 inches. The hight between spindle and base plate can be varied from 3 feet 9 inches to 8 feet, the base plate being 6 feet wide by 12 inches thick and the whole machine weighing 19 tons. There are 16 spindle speeds.

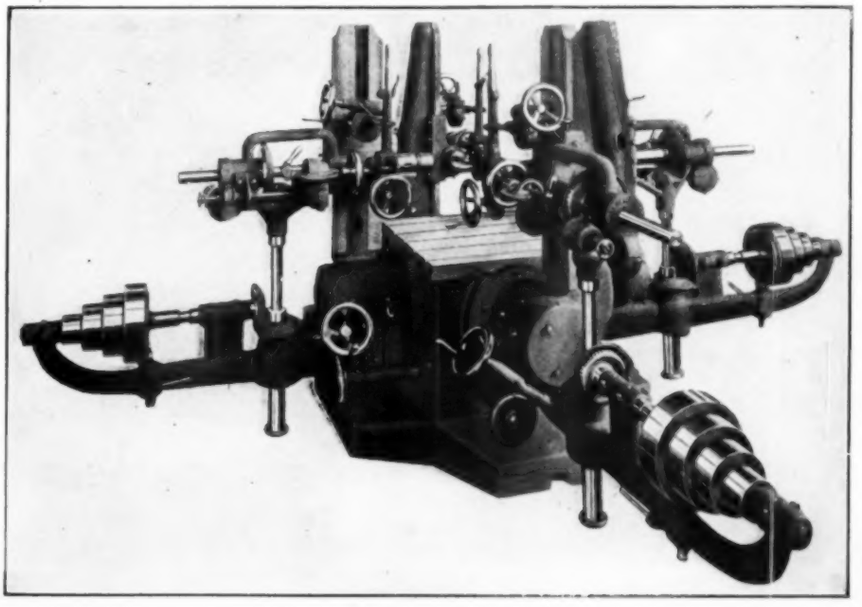
The work is shown mounted on a Wolfensberger tilting work table which allows the work to be handled very readily. The machine is built by William Asquith, Ltd., Halifax, England.



ENGLISH RADIAL DRILL WITH CENTRAL THRUST ARM

Four Headed Horizontal Drilling Machine

This is a somewhat unusual form of drilling machine with a head on each side of a 30-inch square table. Each drilling head is mounted on a trunnion, and can be moved around this by the worm-operated gearing shown. In addition to this the heads can be moved vertically on the uprights so that the drilling spindle

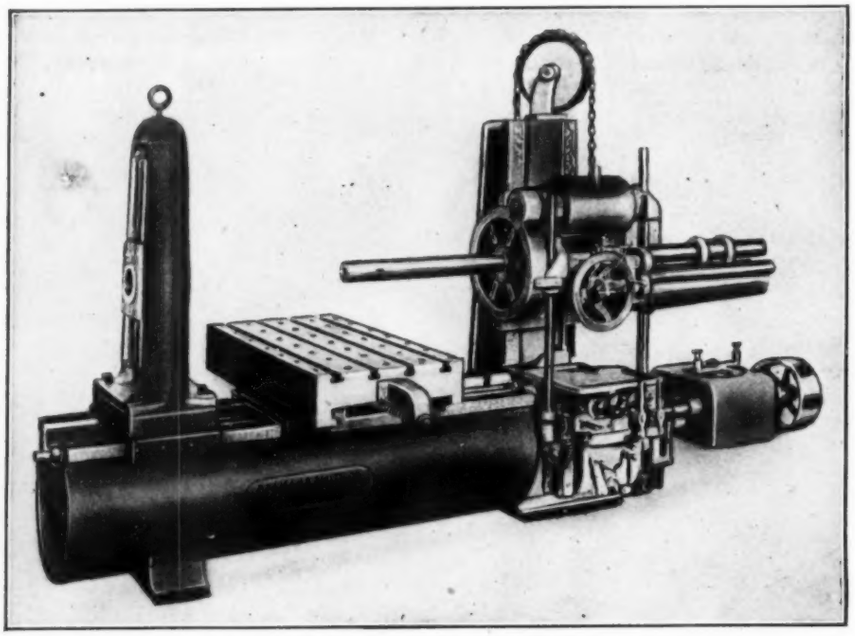


FOUR-HEADED HORIZONTAL BORING MACHINE

can be brought to any desired position with relation to the table.

These heads are the same as used for the regular No. 3 horizontal radial drilling machine built by the same firm, the W. F. & John Barnes Company, of Rockford, Ill. This special application was for a piece of work having two different sized holes on each of its four sides, which required boring, drilling and tapping. This arrangement allowed the work to be strapped to the table while the movements of the drilling heads give the other locations.

The distance from the center of the trunnion to maximum hight of spindle is 38¼ inches, the table taking out 8¾ inches of this. The saddle has a bearing of 9x12 inches. The radial arm moves through 180 degrees, while the spindle has a traverse of 18 inches. It will drill and tap to 3 inches in cast iron, and 2 inches in steel.



NEW BEAMAN & SMITH BORING AND MILLING MACHINE

New Boring and Milling Machine

The Beaman & Smith Company, Providence, R. I., is building the boring and milling machine shown herewith, calling it their No. 10. The special feature is the cylindrical or tubular form of the bed, the column, the head support and the outer bearing. In this machine the ways for carriage are 20 inches wide by 6½ feet long; the table is 24x48 inches with a cross power feed of 36 inches.

The head is balanced and has vertical power feed and quick traverse for milling. The spindle is 3½ inches in diameter; has a No. 5 Morse taper; a continuous feed of 30 inches, which can be repeated by "fluting," or taking a new hold on the spindle. The head has a vertical movement of 22 inches.

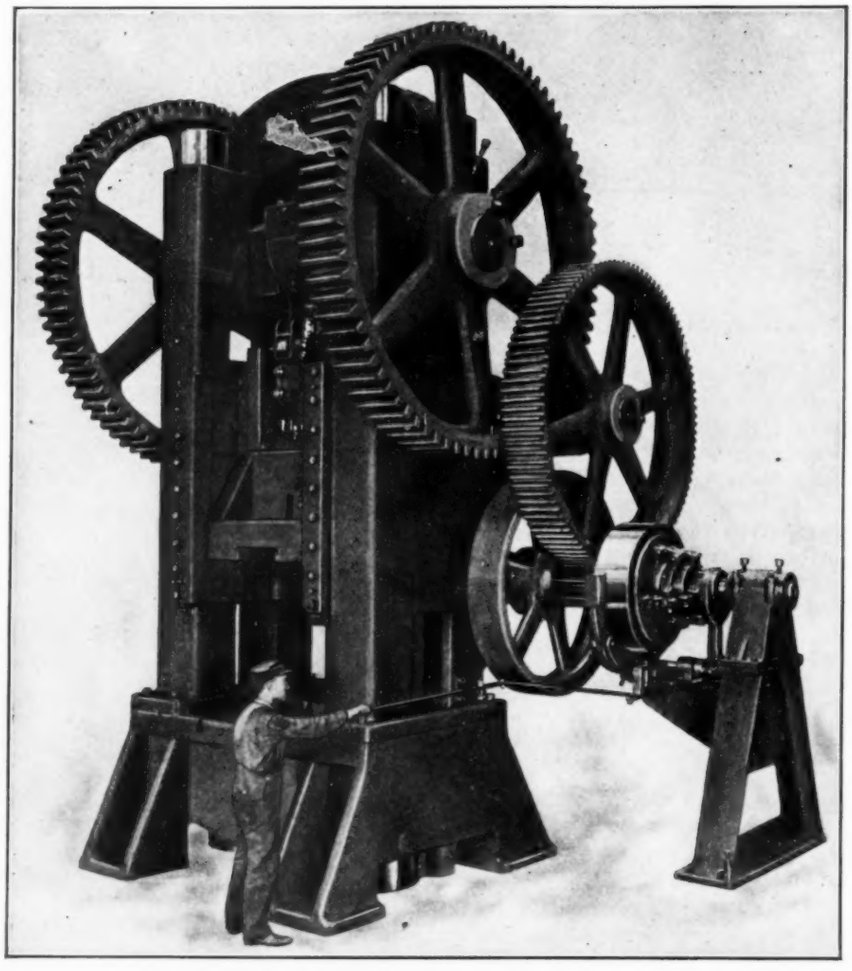
There are 18 changes of speed, from 4.34 to 125 revolutions per minute, obtained from speed box at the right. The boring feeds are 8 in number, from 0.009 to 0.252 inch per revolution of spindle. For milling, these range from 0.56 to 15.7 inches per minute for any spindle speed. The drive is by a 5-inch belt on a 14-inch pulley, giving ample power. It weighs 11,000 pounds.

A 164,000 Pound Single Action Press

The straight-sided, single-crank, single-action press shown in the acompanying illustrations has recently been built by the E. W. Bliss Company, Brooklyn, N. Y., for the Hydraulic Pressed Steel Company, of Cleveland, Ohio. This is supposed to be the largest press of this type ever built, the shaft being 15 inches in diameter, and its total weight 164,000 pounds.

Four vertical steel tie rods of large diameter, receive all the strain from pressure exerted when the press is in operation, relieving the frame columns of all working strain. The bed is 60x48 inches and the slide weighs over seven tons. Each of the main gears weighs over six tons.

The machine is controlled by a hand lever operating a combined friction clutch and brake. An improved safety coupling



A LARGE SINGLE-ACTION PRESS

is attached to the flywheel as a safeguard against excess pressure.

A Toolroom Combined Bench Center and Centering Machine

Some two years ago we published cuts from the students' drawing of a bench center built at the Artisan School, of Syracuse, N. Y., and we now give a halftone view, Fig. 1, of the same machine, complete as originally intended, arranged to drill and countersink, as well as the arrangement for correctly locating the centers.

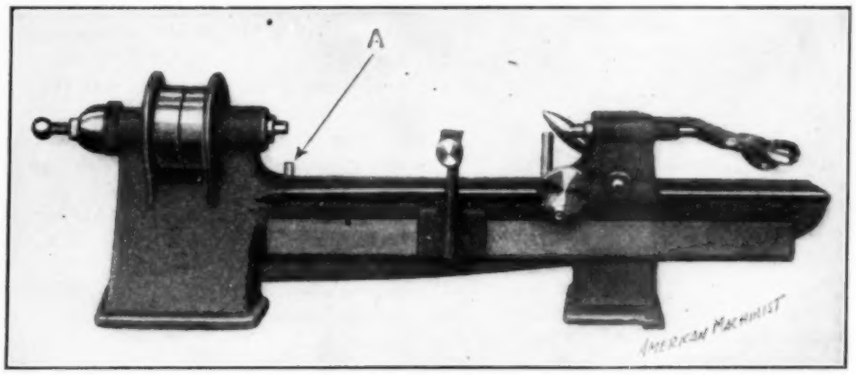


FIG. 1. COMBINED TOOL-ROOM BENCH CENTER AND CENTERING MACHINE

The arrangement for locating the centers consists in a graduated feeler used in the place of chalk, which in the old way marked the high side of a piece, whereas the feeler not only locates the smallest point in the piece being tested (which is what the operator wants to know), but indicates as well just how large that particular part of the bar will hold up to. This feature of the machine remains the same, but there is added the revolving shaft for running a combined countersink and drill.

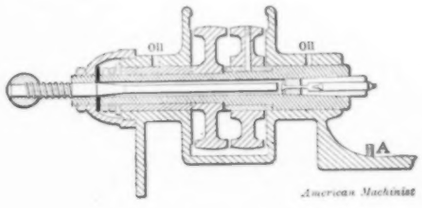


FIG. 2. SECTION OF HEADSTOCK

The tight and loose pulleys run between stationary flanges; the tailstock spindle has an operating lever as well as a spring to hold the center in contact when testing; and the small crank at the front of the tailstock adjusts V pieces to properly support the end of the piece to same, as the third hand an operator sometimes wants.

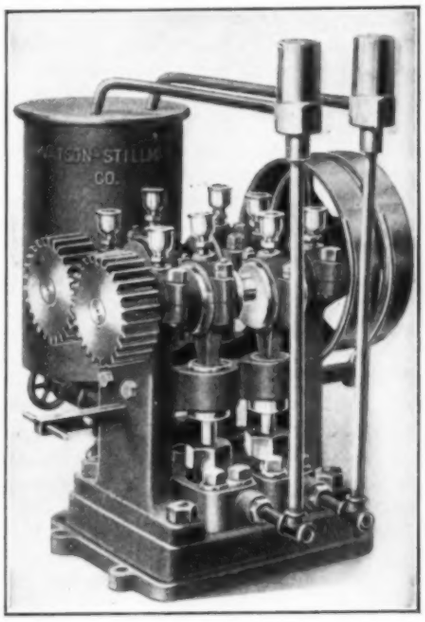
To facilitate the setting of the tailstock, the piece is laid on the bed against a stop at *A*, and the tailstock brought against it, which locates it properly—both for testing the centers or drilling. The arrangement of knockout for changing from center to drill, or the reverse, is new.

It will be seen by Fig. 2 that the step is a stationary piece, and in this an enlargement of the knockout rod fits; the smaller portion is held central in the spindle without contact.

There is also a light spring which withdraws the rod a little way so that when another center or drill is put in the rod is not driven out. The ball on the end of the rod is sufficiently heavy to serve as a hammer. There is a shelf for chalk, and the chucks and center fit holes in the back of the head for their retention.

A Small Hydraulic Pump

The four-cylinder, two-pressure line hydraulic pump illustrated represents a new type by means of which one, two, three or four pressure lines may be served independently of each other, but from a common reservoir. Each pressure line has a separate pressure chamber, safety valve and release line and is served by a separate pair of cylinders (½-inch diameter by ½-inch stroke) having eccentrics set to give a continuous flow. Any pressure up to 60 pounds per square inch may be delivered into any line, the limit in each instance being determined by the setting of the safety valve, which opens as the pressure tends to exceed the limit and lets the surplus liquid pass back through the release pipe to the reservoir. Any pressure line can be thrown out of service entirely by opening the safety valve, in which instance all the liquid in that line pumps directly back to the reservoir.

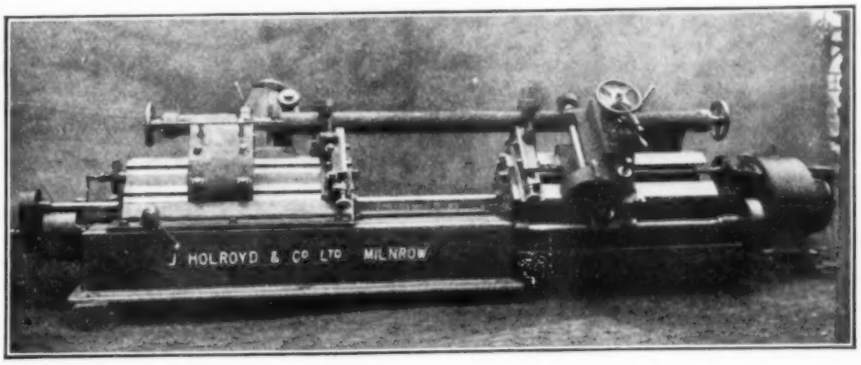


SMALL HIGH-PRESSURE PUMP

The one-, two-, three- and four-pressure-line pumps are practically the same in design save for change in the length of the bed plate and the shafts to accommodate the required number of pressure chambers, cylinders, piston rods, eccentrics, etc., and may be fitted with an electric motor instead of the pulley shaft shown. These pumps are made by the Watson-Stillman Company, of New York.

Cutting Keyways in Axles

The firm of J. Holroyd & Co., Limited, Milnrow, England, has recently made the machine illustrated for milling keyways in straight axles or in left-hand leading crank axles, no other positions being cut at



MILLING MACHINE FOR CUTTING KEYWAYS IN AXLES

both ends of the axle simultaneously. The machine will take axles 10 feet long between centers down to a minimum length of 3 feet, the maximum width between the webs of the crank being 4 feet, while the maximum and minimum diameters of the axles are 12 and 3½ inches, respectively. The machine will cut keyways up to 1¾ inches wide.

The main bed carries two small beds, one of which is adjustable along the length by rack and pinion. Each of these beds carries a milling head, poppet head and steady rests or stays for the job. The cutter heads slide on the beds as shown and can be fed either by hand or power by three-speed gear and worm and worm wheel on the screw, a knock-off motion dropping the worm out of gear at any desired point, while the ratio of the gearing is 9½ to 1. The spindles may be driven by belt or by motor at one end of the main bed. The spindle slides are adjustable vertically on the head. Cutter speeds range from 30 to 60 revolutions per minute, and at the latter the feeds are 2, 3½ and 6 inches a minute. The driving motor is of 10 horsepower. It occupies a space of about 20x7 feet, and weighs 6 tons with the motor.

A Handy Way of Pressing Work Together

A very handy method of assembling differential gear casings for automobiles was

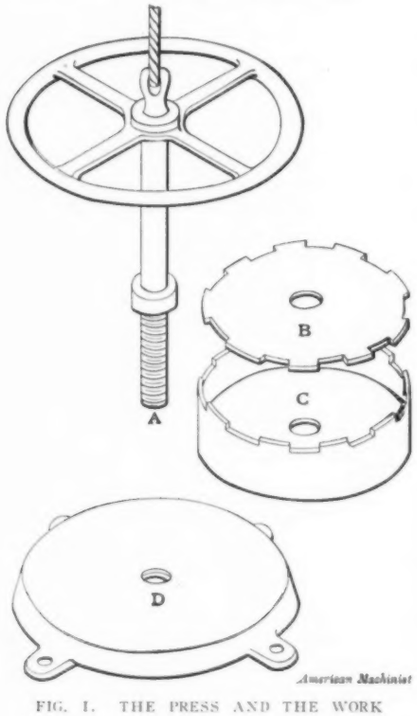


FIG. 1. THE PRESS AND THE WORK

recently seen in the shops of the Providence Engineering Works, Providence, R. I. The casing in question has a cover with teeth milled in the rim which fits into similar openings in the body as can be seen at *B* and *C*. These are a good fit and would ordinarily be forced into place with a soft hammer or in some similar way.

The press used is very simple, consisting of a base *D* with a threaded hole in the center. Suspended above the bench is the wheel with the screw *A* fitting the hole in *D*. The whole screw is counterbalanced from above as indicated by the rope.

The body *C* is placed on the base, the cover *B* laid on and the screw *A* brought

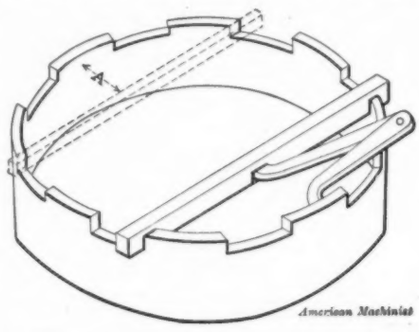


FIG. 2. TESTING THE SETTING OF THE MACHINE

down and screwed into the hole in *D*. The collar on *A* forces the cover plate *B* down squarely and evenly, without any hammering or danger of getting it canted to one side.

A press of this kind has a wide field of usefulness and can be easily modified to meet almost any condition.

Testing the Body Slots

The body slots are milled by a pair of straddle mills so spaced as to require indexing around but once to cut all the teeth. This requires careful setting of the machine which is tested in the manner shown in Fig. 2.

After cutting a body a straight steel bar is laid across two of the slots as shown and the distance *A* measured. Then it is laid across another similar pair of slots and tested on each side. This method may also find application in many different kinds of work.

Classification of United States Patents

The reclassification of patents (contrary to reports appearing in the daily press) which is now in progress at the United States Patent Office is not a new undertaking, although it has been advanced rather more rapidly of late. Several years will probably be required to finish the work unless Congress should make more liberal appropriations for the support of the scheme. This latter is much to be desired, as the work will, according to expectations of competent men, do away with two-thirds of the difficulty of searching patents, and to a corresponding extent will tend to lighten the burden of expense resting upon inventors.

The number of patents now in existence at the Patent Office is nearly 3,000,000, of which 2,000,000 or more are foreign and 900,000 or more are American. These patents have always been classified in some way, inasmuch as only by some such method could any order be maintained or any searching of patents be rendered possible. The various classes of patents, however, have always had a tendency to grow and this growth has frequently been in unforeseen directions. Probably the year 1884 is the last date in which the old classification could be said to be up to date. Subsequent to that time, the constantly increasing pressure of work in the office rendered it practically impossible to keep up examinations of cases, and at the same time maintain the classification in proper condition. As a result of the smallness of the force and of the difficulty of the situation, many lines got behind and the confusion tended to increase.

Some years ago a classification examiner was appointed in accordance with an act of Congress, and after looking into the problem he recommended certain lines of reclassification of patents, and undertook the work. The original plan of the work was to class the various patents by mechanisms rather than by the purpose of the invention, and this is the plan that, with some minor modifications, is now being pursued. For example, a punching machine may be either a machine for punching metal or for punching paper. Under the old classification it would have been placed, in the former case, under metal-working machinery, and in the latter under machinery for manipulating paper. The present idea would be to place all punching machines together in one class. The results of the classification so far as it is accomplished are being put out from time to time in bulletins, which exhibit the changes that are actually introduced. A systematic general grouping is, of course, being sought as against the present unsatisfactory and unsystematic method. There are now about 250 classes of patents and from 6 to 350 subclasses in each group. The new grouping will not only develop a better arrangement, but will seek to balance the subclasses as evenly as possible. More subclasses and subdivisions are being created to the end that patents in any particular line may be reached more easily. In general, in establishing the new subclasses, the object sought is to get together into a single subclassification all devices relating to any one feature of a given invention. Thus under the general class "gas engine" one distinct subclassification will be "spark plug." Probably not more than 100 patents ought to figure in any subclass, if it is possible to maintain the grouping with that limitation.

Patent attorneys regard the progress of this work with much favor, inasmuch as it will relieve an extremely difficult situation and will make it possible for them to carry on their work with much greater accuracy and assurance than at present.

Forthcoming Meetings

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

Society of Automobile Engineers, annual meeting, January 4, 1910, Automobile Club of America, New York City. Alex. Churchward, secretary, 2 Rector street, New York City.

Society of Automobile Engineers, professional meeting, January 13, Engineering Societies building, New York City. Alex. Churchward, secretary, 2 Rector street, New York City.

Business Items

The Q. M. S. Company, Plainfield, N. J., has moved its western office from 1775 Old Colony building to 738 First National Bank building; John C. Hoof, manager.

Business Opportunities

E. B. Hayes Machine Company, Oshkosh, Wis., will erect a new shop.

Mogul Wagon Works, Hopkinsville, Ky., will build an addition to its plant.

Sears, Roebuck & Co. will build a new shoe factory at Littleton, N. H.

Swift & Co. will erect a packing plant near Seattle, Wash., to cost $1,500,000.

The American Velvet Company, Stonington, Conn., is erecting an addition.

The Wheeling (W. Va.) Stamping Works will build an addition to its plant.

The Badger Brass Company, Kenosha, Wis., is building an addition to its plant.

The American Seeding Machine Company will enlarge its plant at Richmond, Ind

The Wayne Company, Newark, N. J., will erect a factory for making paper boxes

The W. E. Leard Machine Company, Beaver, Penn., is preparing plans for a new plant.

The Ashworth-Odell Worsted Company, Jamestown, N. Y., will erect a new factory.

The plant of the Mitchell Lewis Wagon Works at Racine, Wis., was destroyed by fire.

The Joseph Reid Gas Engine Company, Oil City, Penn., is erecting a new pattern shop.

The Kewanee (Ill.) Boiler Company has purchased site for an addition to its plant.

The Titusville (Penn.) Forge Company is asking for bids for the erection of an addition.

The Hammond Fire Brick Company, Fairment, W. Va., will rebuild its plant recently burned.

G. W. Hammers, of Colorado Springs, Colo., will build a plow factory in Pueblo to cost $50,000.

The Crown Cork and Seal Company, Baltimore, Md., will erect an addition to its brass foundry.

The Sinclair Laundry Machinery Company, of Chicago, Ill., is negotiating for a site in Joliet, Ill.

The plant of the Shelby (N. C.) Machine and Supply Company was burned. Loss, about $15,000.

The Croxton-Keeton Motor Company, Massillon, Ohio, has let contracts for the erection of an addition.

The Gilbert Corrugated Culvert Company, of Austin, Minn., will establish a plant in Aberdeen, S. D.

The main mill of the Jewett Car Works, Newark, Ohio, was destroyed by fire. Loss, about $150,000.

The electric-light plant owned and operated by W. A. Potter at Mizpah, Minn., was destroyed by fire.

It is reported the International and Great Northern Railroad will build its boiler shop in San Antonio, Tex.

The American Pulley Company, Philadelphia, Penn., has bought more ground for an addition to its plant.

The Monrovia (Cal.) Planing Mill Company will build an addition for the manufacture of light furniture.

It is rumored the Louisiana Railway and Navigation Company is to build shops in or near Baton Rouge, La.

Fire destroyed the plants of the Michigan Cash Register Company and Gray Furniture Company, Detroit, Mich.

The Davis Safe and Lock Company, Portland, Ore., has let contract for the erection of a new factory building.

The Augustine Rotary Engine Company has purchased site in the Black Rock section of Buffalo, N. Y., for a plant.

Raymond & Hoffman, Denver, Colo., are having plans prepared for a new packing plant to cost about $75,000.

The Rome (Ga.) Cooperage Company, recently incorporated, will erect a plant for the manufacture of barrel heads.

The plant of the Towle Syrup Company, St. Paul, Minn., was destroyed by fire. Loss, $100,000. It will be rebuilt.

The Avery Company, Peoria, Ill., building traction engines, is having plans prepared for a large addition to its plant.

The Superior Machine Tool Company, Kokomo, Ind., is extending its facilities and requires some additional equipment.

The Muskogee (Okla.) Foundry Company will build an addition, doubling the capacity of its foundry and machine shop.

The Minnesota Woodenware Company, Minneapolis, Min., whose plant was recently burned, will rebuild in Foley, Minn.

The Cream City Trimming Company, Milwaukee, Wis., will erect a new building for the manufacture of automobile tops.

The Erd Motor Manufacturing Company, Saginaw, Mich., will build a new plant for the manufacture of gasolene engines.

The Connecticut Telephone and Electric Company, Meriden, Conn., is having plans prepared for an addition to its plant.

The six-story factory of Schrack & Sherwood, Philadelphia, Penn., making undertakers' supplies, was destroyed by fire.

The Vulcan Steam Forging Company, Buffalo, N. Y., will erect an addition. Is in the market for a 2000-pound steam hammer.

The United States Envelope Company, of Worcester, Mass., is said to be contemplating the erection of a plant in San Francisco.

The Marshall Lumber Company, Muskogee, Okla., will build an addition for the manufacture of window sash, door frames, etc.

The Dayton (Ohio) Computing Scales Company has purchased site for a new plant to replace the one recently destroyed by fire.

The Cherryvale (Kan.) Iron Works will purchase about January 1 some new equipment, including cranes, motors, shafting, etc.

The Smith Manufacturing Company, Bessemer, Ala., whose plant recently burned, will rebuild. The company manufactures stoves and castings.

The Denver (Colo.) City Tramway Company has taken out permits for the erection of a power house to cost $30,000 and two additional stations.

The Sayers & Scoville Company, Brighton, Cincinnati, O., is planning the erection of a large addition to be used for the manufacture of automobile trucks.

The Kansas City-Southern Railway will erect terminals in South Leesville, La., including roundhouse and yards. A. F. Rust, Kansas City, Mo., engineer.

Frank P. Allen & Sons are preparing plans for a machine shop which C. C. Tuxbury will build on South Market and Fulton streets, Grand Rapids, Mich. This will be used for manufacturing automobile engines.

It is expected that the plant of Radcliffe Brothers, manufacturers of hosiery and underware, at Shelton, Conn., will be rebuilt. The plant was partly destroyed by an explosion recently, causing a loss of about $100,000.

The Allen Engineering Company, Memphis, Tenn., newly incorporated with $40,000 capital, has bought site for a plant and will engage in general engineering, steel construction and foundry work. Thomas H. Allen, N. Hill Martin, H. L. Alexander and others, are incorporators.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., January 10, for guy derricks and hoisting engines, steel castings, iron forgings, hoisting chain, brass tubing, cast-iron pipe, wood-boring machines, machinists' taps, wrench jaws, files, tinners' shears, etc., as per Circular No. 548.

Trade Catalogs

S. A. Wood Machine Company, Boston, Mass. Catalog of inside molders. Illustrated, 38 pages, 6x9 inches, paper.

Pratt & Whitney Company, Hartford, Conn. Book showing work ground on vertical surface grinder with time required. 24 pages, 9x12 inches.

American Spiral Pipe Works, Chicago, Ill. Pamphlet No. 30, describing Taylor spiral riveted pipe, forged steel pipe flanges, etc. Illustrated, 20 pages, 8x10 inches.

B. C. Ames Co., Waltham, Mass. Catalog of bench lathes and fixtures, bench milling machines, jig filing machines, dial gages. Illustrated, 50 pages, 7x9 inches, paper.

The Cincinnati Milling Machine Company, Cincinnati, Ohio. Catalog describing horizontal and vertical milling machines and cutter grinders. Illustrated, 160 pages, 6x9 inches, paper.

Sprague Electric Company, 527 West Thirty-Fourth street, New York. Bulletin No. 110, describing Type S continuous current direct-driven generators for lighting and power. Illustrated, 24 pages, 8x10½ inches.

General Electric Company, Schenectady, N. Y. Bulletin No. 4705, illustrating and describing Curtis steam turbines for low pressure and mixed pressure. 12 pages, 8x10½ inches. Pamphlet No. 3885 entitled "Dawn of a New Era in Lighting," showing development from the candle to the tungsten lamp.

General Electric Company, Schenectady, N. Y., Bulletin No. 4702, describing the application of Curtis steam turbine to pumping equipment of fire boats. Illustrated, 16 pages, 8x10½ inches. Form No. 3874, illustrating and describing Tungsten automobile electric lamps. Form No. 3878, describing Mercury arc rectifiers. Illustrated.

International-Acheson Graphite Company, Niagara Falls, N. Y. Pamphlet entitled,

"Seventeen Years of Experimental Research and Development," by Edward Goodrich Acheson, reprint of address delivered before the American Academy of Arts and Sciences, Boston, Mass. Booklet, describing Oildag and its merits as a lubricant. Illustrated, 32 pages, 3½x6 inches.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Man with good experience wants position to take charge of tool room or manufacturing department on small or medium size work; have handled both. Box 26, AMER. MACH.

MASSACHUSETTS

Technical graduate, mechanical, three years' experience in drafting room and shop, desires a position in which there is a future. Box 35, AMERICAN MACHINIST.

MICHIGAN

Wanted—By first-class mechanic, well up in modern machine shop and tool room practice, position as assistant superintendent or general foreman; can furnish best of references; location not material. Box 8, AM. M.

Shop superintendent or foreman; practical mechanic and executive in machine building, cost reducing and up-to-date methods of manufacturing interchangeable parts; 20 years' experience; best of references. Box 17, AM. M.

NEW JERSEY

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

Office executive and systematizer, 33, thoroughly trained, seeks responsible position; 15 years' machine manufacturing experience; master of all office details, excellent correspondent, experienced advertiser, good executive ability and an organizer with capacity to do things; references the best. Box 6, AMERICAN MACHINIST.

NEW YORK

Draftsman familiar with telephone switchboard design and conduit plan; now employed. Box 21, AMERICAN MACHINIST.

I want to connect with established concern that needs more business and mechanical energy and where I can purchase an interest; technical and practical; mature experience; machine shop and foundry; record straight and good. Address "Reliable," AMER. MACH.

Some exceptional ability for sale; I am open for a position as general superintendent or factory manager; to this work I guarantee to bring ability that will get your product out at the least cost, with smallest equipment; and to prove this by my past record for just such accomplishment; may I hear from you with details, before January 1. Box 31, AM. MA.

OHIO

Are you looking for a first-class designer with engineering education and experience. If so, address Box 34, AMERICAN MACHINIST.

Wanted—Position as superintendent or general foreman; fifteen years' practical steam and gas engine experience; now employed; good reasons for wanting change. Box 22, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Steam shovel designer; wanted man with wide experience in their design and construction. Address, stating experience, Box 25, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Tool draftsmen; preferably those having had experience on automobile tools. Apply to the Pope Manufacturing Company, Hartford, Conn.

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

ILLINOIS

Wanted—Draftsman who has had experience in designing surface grinders; state experience and references. Box 24, AM. MACH.

Wanted—Assistant foreman for pattern shop making a full line of machinery patterns; must have had experience in handling men. Address giving full particulars, Box 32, AMERICAN MACHINIST.

Wanted—Mechanical engineer, draftsman and designer, exclusively for building presses, automatic machinery and dies for sheet-metal work; state experience and give references; location Middle West. Box 15, AMER. MACH.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

MICHIGAN

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—Toolmakers, diesinkers, machinists, automatic screw machine operators; also Jones & Lamson men for setting up; milling machine hands and blacksmiths; first class men only; state age, experience and wages. Apply Buick Motor Company, Flint, Mich.

MISSOURI

Wanted—Mechanical draftsman who has had experience designing woodworking machinery; state age, experience and give references. Apply Box 14, AMER. MACHINIST.

Wanted—An experienced man as foreman of machine shop employing about 100 men, who thoroughly understands the manufacture of woodworking machinery; must have occupied similar position; applicant will state age, experience and give references. Box 13, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Mechanical draftsman; experienced on valves preferred. Box 33, AMER. MACH.

NEW YORK

Wanted—First-class diemakers on blanking, forming and drawing dies for novelties, light and medium stampings; steady employment in a modern shop to competent men. Box 28, AMERICAN MACHINIST.

Wanted—By automobile manufacturer, several first-class draftsmen; state where at present employed, experience, age, salary and how soon you could report for work. Box 27, AMERICAN MACHINIST.

Wanted—For New York territory, an experienced printing-press salesman to represent an old established concern; only competent men need apply, stating salary and full particulars; confidential. Address Box 18, AM. M.

Wanted—Draftsman for designing of machine tools and for laying out jigs and changing machine tools. In answering state experience and wages expected. De La Vergne Machine Company, Foot East 138 St., New York City.

Wanted—An expert mechanical draftsman who has had considerable experience in laying out machine shop equipments and arranging machinery; also who has had experience in connection with purchase of machinery; a good salary for the right man. Apply "W. L. A.," AMERICAN MACHINIST.

Shop superintendent wanted to take charge of machine shop, structural shop and foundry near New York, making power transmission machinery, conveyers, etc.; experience in the manufacture of cast-iron pulleys and hangers is essential; a good salary will be paid to a bright, hustling, practical man who can handle about three hundred men, take charge of manufacturing, and at the same time reorganize and repair a plant equipment that has been somewhat neglected. Address reply, stating experience to "Superintendent, P. O. Box 824, New York."

OHIO

Wanted—Mechanical and electrical foreman, experienced in electric and steam power, heat, light and general millwright work; capable of having complete charge of power plant and all machinery with a large manufacturing company. Box 19, AMERICAN MACHINIST.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Toolmakers, first class for jig work; must be competent machinists and bench workers able to assemble motorcycle engines; steady work; state previous experience, employment and wages. Address "Machinist," P. O. Box 1592, Philadelphia, Penn.

Wanted—By a large ice machine manufacturing company, several mechanical draftsmen, competent to lay out ice and refrigerating plants; state age, experience, salary expected and give references. Address Box 36, AMERICAN MACHINIST.

Wanted—Foreman for small shop manufacturing medium weight specialties; must be familiar with modern methods and systematic; state age, experience and whether married; a good salary will be paid to the right man. Box 988, AMERICAN MACHINIST.

Wanted—High classed man as foreman of tool room and machine shop; must be able to design tools for rapid production of work; should have some experience on dies for forming heavy sheet metals; good chance for advancement for high class man. Box 30, AM. M.

Wanted—First-class machine fitters, vertical boring mill hands, horizontal boring mill hands, wood pattern makers, universal grinders, instrument makers, automatic screw machine hands, shaft grinders, tool setters, first-class engine lathe hands, brass molders. Apply at Westinghouse Electric & Mfg. Co.'s Employment Department, East Pittsburg, Pa.

Wanted—First class mechanical draftsman to take charge of small drawing room; must be good estimator and have had experience in designing machine tools for special work; must have executive ability enough to direct men in estimating and designing any special tools required; give full experience, reference, age and compensation expected; also when available. Box 23, AMER. MACHINIST.

Manufacturer in Philadelphia wants competent man for metal patterns, small brass and iron work made in quantity on molding machine (Tabor specially); good mechanic, able to do nice work on lathe shaper and miller; man for this job must be more or less of a toolmaker and no wood pattern maker. Answer only from near New York or Philadelphia. Address with age, experience and salary; steady position for right man. "Electrical," Box 4225, Station G, Philadelphia.

Wanted—Superintendent for foundry and machine works employing from 150 to 200 hands engaged in manufacture of single and four valves automatic engines and general foundry work; must be thoroughly abreast of the times, practically and theoretically capable of taking entire charge of manufacturing departments and of acting in capacity of advisory engineer; position open January 15, 1910. Address, stating experience and with references, "Inertia," care AMER. MACHINIST.

RHODE ISLAND

Wanted—Twenty-five first class tool designers; steady employment for men who can do the work in a satisfactory manner. Address The Taft-Peirce Manufacturing Company, Woonsocket, R. I.

Wanted—Twenty-five first class tool and die makers on blanking, perforating and bending dies; steady employment for men who can do the work in a satisfactory manner. Address The Taft-Peirce Manufacturing Co., Woonsocket, R. I.

Wanted—Twenty-five experienced draftsmen to design all classes of special tools for the economical manufacture of interchangeable machine parts; steady employment to capable men. Address The Taft-Peirce Manufacturing Co., Woonsocket, R. I.

VERMONT

Wanted—A general foreman to take charge of 50 men on night work; hours 4:30 p.m. to 2 a.m.; must be familiar with turret and milling machines; a permanent position to right man; give age, experience and salary expected. Box 29, AMERICAN MACHINIST.

VIRGINIA

Wanted—Machine shop foreman; systematizer and hustler; state salary expected. Westbrook Elevator Company, Danville, Va.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Drawings for automatic and special machines made; designing pumps, attention given. Address "Mechanical," Box 1, AM. MA.

Would like to contract with machinery builders to furnish castings of medium weight. Lewistown Foundry and Machine Company, Lewistown, Pa.

Machinery to manufacture on contract; designers, patternmakers and founders; we can handle work from very light up to 15 tons. Hydrostatic Machinery Co., Rochester, N. Y.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

Important technical office, having widest connection in Italy, is prepared to treat with a first class machine manufacturing firm. Write to Ing. Michele S. Foa, Turin, Italy, Corso Oporto 31 bis.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Wanted—To purchase a machine and foundry business, employing not less than fifty men; must have an established trade, show good profits and good reason for selling; purchasers wish business to combine with other lines now being manufactured. When writing give full particulars. Box 940, AMERICAN MACHINIST.

THE ANNUAL MEETING of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck Building, 497-505 Pearl St., Borough of Manhattan, New York City, N. Y., on Tuesday, January 25, 1910, at 12 o'clock noon. Dated, New York City, December 6, 1909. Robert McKean, Secretary.

For Sale

For Sale—Modern new steel brick lined shop and tools, four years in operation; new tools, electric crane, gas engine and motor drive; running day and night since January; owners will retain part interest and give management to right party; located in Central West. Box 760, AMERICAN MACHINIST.

New Incorporations

American Paper Cup Company, Wilmington, Del. Manufacture machines for making paper cups. Capital, $100,000.

McNable Iron Works, Belfast, Me. Manufacture and sale of automobiles. Capital, $100,000. A. W. Keating, president.

Eaton Gas Engine Company, Eaton, Ohio. Manufacture gas engines. Capital, $15,000. Incorporators, L. L. Brown, John E. Parker, etc.

Rex Tire Company, New York. Manufacture auto supplies. Capital, $50,000. Incorporators, M. Ely, C. Fuller, S. N. Richardson, New York.

Hanke Iron and Wire Works, Chicago, Ill. MAnufacture metal goods. Capital, $30,000. Incorporators, R. Hanke, W. R. Kavanaugh, A. W. Hanke.

Empire Brush Company, Troy, N. Y. Manufacture brushes, dusters, brooms. Capital, $30,000. Incorporators, T. E. Burns, T. F. Duffy, F. C. Laquer.

American Pattern and Model Comapny, Chicago, Ill. Machine shop and foundry. Capital, $10,000. Incorporators, W. P. Bond, E. Banning, F. M. Frost.

Cutting Motor Company, New York. Manufacture motor cars, automobiles, etc. Capital, $100,000. Incorporators, H. Rosenberg, H. J. Jones, H. M. Browne.

Emmons Electric Company, Chicago, Ill. Manufacture electrical supplies and fixtures. Capital, $10,000. Incorporators, C. T. Rost, C. P. Emmons, H. W. Huttmann.

The Webb Jay Motor Company, Dunkirk, N. Y. Manufacture automobiles, cars, motors, etc. Capital, $500,000. Incorporators, R. J. Grass, C. F. Hakes, W. C. Marsh, etc.

The Scranton Lees Gas Governor Company, Scranton, Penn. Manufacture gas governors. Capital, $75,000. Incorporators, George M. Halstead, Chas. E. Jenkins, James C. McCall.

White Star Taxicab and Garage Company, Chicago, Ill. Manufacture and deal in automobiles. Capital, $50,000. Incorporators, H. J. Guttman, W. J. Stewart Hyde, E. D. Fritch.

The Buck Airship Company, New York. Manufacture motors, engines and vehicles for traveling in the air. Capital, $50,000. Incorporators, J. W. Buck, F. W. Greene, W. Leiber.

Van Dyke Motor Car Company, Detroit, Mich. Manufacture commercial trucks. Capital, $1,000,000. Incorporators, Frank G. Van Dyke, George B. Davis, George C. Clark, etc.

The Castings Company, Chicago, Ill. Manufacture and deal in iron, steel, copper, manganese and other materials. Capital, $10,000. Incorporators, W. H. L. Bell, Dwight S. Robb, A. G. Miller.

Standard Sanitary Couch and Chair Company, Philadelphia, Penn. Capital, $100,000. Incorporators, C. S. Metcalf, G. M. Skeen, G. R. Demontlord. Manufacture folding beds and chairs.

American "Z" Electric Lamp Company, Jersey City, N. J. Manufacture electric lamps, etc. Capital, $1,000,000. Incorporators, H. Brunner, A. Romberg, Paris, France; B. Treacy, Jersey City.

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Norton Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Accumulators, Hydraulic

Watson-Stillman Co., New York.

Aerochuck, The

Manufacturers Equipment Co., Chicago, Ill.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

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Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Niles-Bement-Pond Co., New York.
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Belt Shifter

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Link Belt Co., Phila., Pa.

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American Spiral Pipe Works, Chicago, Ill.
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McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, Ohio.
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